Investigations at the Pueblo Alto Complex

Chaco Canyon

Volume III

Part 1

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Chaco Canyon

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ARTIFACTUAL and BIOLOGICAL ANALYSES

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Front cover: Pueblo Alto and New Alto on the mesa overlooking Chaco Canyon to the southeast (Courtesy of David Brill ©1980).

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Introduction

Thomas C. Windes

Analyses of the material culture and ethnobotanical materials recovered from the excavations at Pueblo Alto are presented here, with the exception of the coprolite, pollen, and human parasite results, which were published previously (Clary 1984; Cully 1985; Reinhard and Clary 1986; respectively). These analyses covered a span of many years and were interspersed with reports and field work involving other sites of the Chaco Project. For the most part, analyses of the Pueblo Alto materials were conducted after those for the other sites of the project were completed. This allowed many of the procedural and computer problems that plagued the initial analyses to be solved before the work on Pueblo Alto began, and it also allowed incorporation of the results from small sites to be compared with these from the Pueblo Alto.

A coordinated effort by all analysts working synchronously on the Pueblo Alto material was not achieved, however. Furthermore, much of the architectural and stratigraphic information from the Pueblo Alto excavations (Volume II) and temporal refinement (in Volume I) was not available to the analysts, except in a general way, that would have helped to structure the analyses. The pitfalls of combining theoretical and practical planning of large-site excavation and analysis impinged on the harmonious drive toward the final analytical goals, preventing all that had been desired. Nevertheless, we are happy to present the wealth of information obtained by our work at Pueblo Alto and the new insights from the mass of data that allowed us to broaden our understanding of the Chaco Phenomenon. From the perspective of my first year on the Chaco Project in 1972, it is clear we have made quantum leaps in deciphering the Chaco story in the intervening decade, which are not apparent to those caught in the more recent unraveling of the intricate web of the Chacoan system. Yet, for all that archeologists have done and learned, we have just begun to unlock the Chacoan secrets.

Goals

A number of general goals were sought in the analysis of the Pueblo Alto materials. Some were more appropriate to address than others, given the nature of the analysis and the distribution and quantities of materials. General questions that directed the analyses focused on sources and exchange. It was clear from the onset that Chaco Canyon lacked sources for the complete range of materials recovered from the excavations. How the Chaco inhabitants obtained these materials and from where, the mechanisms of exchange, and the distribution of material types through time and space were paramount interests, particularly in view of the exchange models proposed by Grebinger (1973) and Judge (1979). In addition, the Chaco Center was interested in identifying and analyzing Mesoamerican artifacts to assess the interaction of Chaco with Mesoamerica. Finally, of course, we pursued more traditional avenues of analysis, including artifact function, description of typologies, and artifact distribution through time and space.

Materials from Pueblo Alto were used to test for hierarchial differences in resource acquisition between the large sites and small sites in Chaco Canyon and to examine the models of social ranking between sites in the canyon (i.e., Altschul 1978; Grebinger 1973; Schelberg 1982, 1984). The relative paucity of materials in floor contact at Pueblo Alto, however, was not conducive to intensive examination for tool kits and assemblages associated with specific task-oriented activities. Instead, primary focus rested with large lots of artifacts recovered from the site, primarily in the trash deposits.

Analytical Strategies

The analysis of bulk artifact classes (e.g., ceramic, lithic, and faunal artifacts) was emphasized because of high artifact numbers and their brief descriptions in prior reports at the expense of finished tools. The enormous amount of material left unexamined from earlier excavations in Chaco Canyon compared to the total site inventories meant that most of the cultural material was unreported and undescribed. For instance, Judd (1954) devoted most of his report on material culture at Pueblo Bonito to whole and restorable artifacts and unusual forms. Only a few paragraphs covered the huge piles of fragmented items recovered. The resulting lack of comparative data from the bulk categories recovered in Chaco Canyon made analyses a priority for those items recovered during the Chaco Project. Unfortunately, because of the lack of description from earlier work, it was not possible to compare the variability and frequency of materials at other Chacoan greathouses with those at Pueblo Alto.

Emphasis at the Chaco Center was on ceramics, chipped stone debitage, and unmodified bone analyses. Each of these categories had a willing staff member to take up their cause. The immensity of the tasks, a small staff, and other ongoing concerns, however, eliminated close examination of some other artifact classes, if they were examined at all. In part, ground stone artifacts were unattractive for in-depth analysis because

past studies suggested that ground stones offered less variation in style, form, and materials through time compared to other artifact classes, and it did not have great potential to contribute to the inquiry of exchange and redistribution. Ground stones comprised an enormous variety of subclasses that would have required much analytical time to define and verify them before inter- and intrasite comparisons could be made. Given the magnitude of the ground stone problem and the limited available staff, the material was divided among several analysts rather than one analyst, and, therefore, suffered the most from the taxonomic split. More important, because of the staff organization and the magnitude of the material, analyses integrating the various categories of artifacts and architectural features were seldom achieved.

A complete inventory was made for each artifact class, and analyses were structured, in part, according to the distribution. Classes with large numbers of items were sampled, although the sampling strategy varied. Generally, emphasis was placed on floor contact materials and trash deposits. Artifacts collected from wall clearing and wall fall were often not analyzed if samples were very large. Examination of the chipped stone debitage and ceramics, in particular, was weighted toward floor and trash deposits. All the unworked bones were analyzed except for the staggering amounts from Test Trench 1 in the Trash Mound and some from Kiva 10, estimated at about 16,000 and 2,700 pieces, respectively. Bones excavated by natural units in the Trash Mound booths were examined, however. Pollen and flotation analyses concentrated on selected floor contact and pit samples, particularly those that could be best compared to similar samples from the excavated small sites in Marcia's Rincon, although a wealth of samples remain for future examination.

A flurry of analyses at the beginning of the Pueblo Alto project yielded reports on the axes and mauls (Breternitz 1976), manos (Cameron 1977), hammerstones (Wills 1977), and projectile points (VerEecke 1977) from sites excavated by the Chaco Center, but, at the time, only the materials recovered from the first season at Pueblo Alto (primarily from wall clearing) were available. Except for a more extensive report on projectile points (Lekson, this volume), follow-up analyses of these materials, recovered later from Pueblo Alto, were not accomplished, although data on the Pueblo Alto manos, at least, was incorporated into the computer files and compared with other sites.

Cultural materials went through three levels of processing, each of which may have generated discrepancies in the frequency of materials listed for each artifact category. In all cases, the archeologist in charge of each area of excavation was responsible for identifying and counting the materials recovered for the initial field inventory (although volunteers and laborers may have done the actual counting and listing). The field laboratory personnel checked these materials as they arrived, cleaned them, listed the appropriate provenience and material culture information on computer sheets for keypunching and eventual computer listing, and boxed the materials for shipment.

At these two levels (field and lab), a number of factors contributed to changes in artifact counts. Foremost among these was a lack of concise definition of various artifacts by staff members (including some tools that were new and that took some time for a consensus to be reached on their identification, e.g., hammerstone/abraders). In addition, some adjustments were made in the laboratory counts after the artifacts were cleaned and could be more precisely identified. Invariably, large numbers of artifacts from a single provenience produced a few materials bagged with the wrong materials. Discrepancies were also inevitable because of the problem of counting small fragments in the bulk categories (e.g., sherds, debitage, bones). Typically, the laboratory personnel inventoried artifacts by following the typology listed on the archeologist's field bags. Artifacts were coded just once at the inventory stage without regard to secondary use. Thus, it is not possible to be certain of the artifact frequency for some categories recovered from Pueblo Alto.

At the final level of artifact identification were the analysts, who have produced the final artifact frequencies listed herein. These varied somewhat from the field tabulations (Table I.1). In most cases the discrepancies between the field and final inventories are minor annoyances. However, major discrepancies exist between some categories of stone tools, primarily ground stones and hammerstones. Some reused artifacts may have been analyzed twice by different analysts based on the perceived primary and secondary uses, or stones with multiple uses may not have been seen by all the analysts in question. Perhaps 5-10 percent of the artifacts in some stone tool categories were affected in this manner. All stone tools need re-examination before any future analyses are attempted.

This issue of artifact frequencies was not resolved, and there are no listings in the following chapters that assist the reader in interpreting how many categories have inflated counts for tools analyzed more than once. The primary differences arise between abraders and other types of ground stones and hammerstones. Many metate and mano fragments, for instance, were reused as abraders. Many mano fragments and some whole manos, at least, were analyzed as abraders but have not yet been analyzed as manos. Probably in some cases tools ground during the manufacturing process also were given abrader status. On the other hand, many of the field-classified hammerstones were analyzed as polishers (see McKenna 1984:241) or hammerstone/abraders. Thus, dividing the ground stones among several analysts may have been logistically sound at the time, but it created problems that are now difficult to rectify.

Chipped stone debitage also suffered some ambiguous treatment. Foremost was the difficulty in how to treat all stone debitage. Considerable waste material was generated from stone reduction, from highly indurated siliceous chert and chalcedony to splintery petrified woods and friable sandstones. Warren's (1979) lithic material classifications, used throughout the Chaco Project analyses, are not mutually exclusive and can be interpreted differently. For instance, the seemingly important split between the predominant categories of silicified wood (1109-1110 and 1112-1113) depends on a subjective determination of the fracturing and refrac-

Table I.1. Materials recovered from Pueblo Alto.

Material type	Number of specimens[a]	
Bones:		
Faunal fragments	ca. 50,000	(30,509 analyzed)
Human bones (scattered)	34	(includes 7 teeth)
Human burial	1	
Worked bone	243	
Chipped stones:	12,585	
Cores		(117)
Debitage		(12,339)
Formal tools (except points)		(40)
Points and point fragments		(89)
Corn kernels, cobs, and fragments	6,182	
Eggshell fragments	1,942	
Fill samples:	2,545	
Conservation		(288)
Flotation		(1,069)
Pollen		(1,105)
Soil		(83)
Hammerstones	854	
Hammerstone/abraders	592	
Glass and cartridges	12	
Ground stones	2,138	
Abraders		(839)
Axe		(1)
Manos and mano fragments		(378)
Metates and metate fragments		(352)
Other worked stones		(568)
Ornaments (nonbone)	561	
Minerals (nonornamental)	2,810	
Manuports	2,498	
Roofing impressions	622	
Sherds	90,123	
Spalls	ca. 30,000	
Vegetal remains (noncorn)	131	
Total	ca. 203,857	

[a]Subtotals in parentheses.

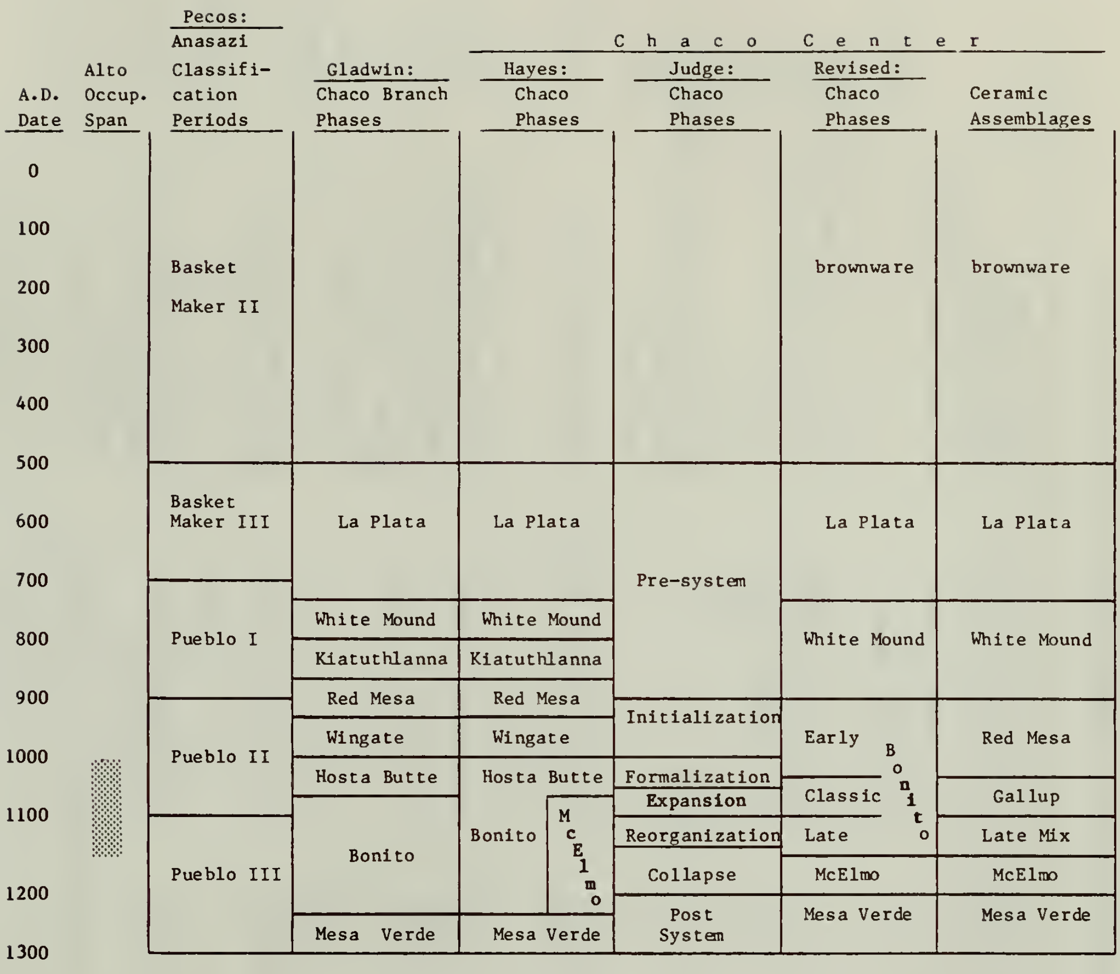
tory qualities of the stones--difficult to make in a consistent manner, given the nature of the petrified wood.

Unlike most sites, Pueblo Alto yielded masses of sandstone debris from wall construction, and this material posed problems for collection and analysis. Occasionally flakes of sandstone ended up with the cherts and chalcedonic material and, thus, entered the chipped stone analysis (Cameron, this volume). Because of the splintery nature of the material, splinters of petrified wood probably were unsystematically collected, although these are not amenable to analyses other than noting material type and frequency. The bulk of the sandstone debris remains unanalyzed, although it was systematically sampled in some rooms. Steve Lekson's interest in greathouse architecture spurred his analysis of about 20,000 sandstone flakes (57 kg) produced from wall construction in the part of Room 139 under Room 145; and these could be studied further (Lekson 1977).

Despite these problems, which are common to any large excavation project, the analyses were highly informative and added much to our understanding of Pueblo Alto and its relationship to the Chacoan Phenomenon. The strength of the analyses is its usefulness for interpreting Pueblo Alto's external links to the Chacoan system, source areas, and comparing the site with the small sites excavated in the canyon bottom. We learned relatively little about intersite relationships at Pueblo Alto, except those based on the broad temporal frameworks, because of the limited excavations and the paucity of material categorized by provenience from previous greathouses excavations.

Because of the long period of time over which these analyses were generated, a number of different phase terms and dates referring to identical temporal periods arose before the final version of this document was written (Figure I.1). Probably some slipped by the editing process or were published in earlier reports, but cross references are provided to help alleviate this problem (Table I.2). Finally, many of the reports (chapters) included here have been widely referenced throughout the Pueblo Alto report and in other reports and publications, including their various revisions. Again, to mitigate reader confusion, a list that cross-references these reports is provided in Table I.3.

Parts of Pueblo Alto have not been consistently labeled in all the reports and publications relating to the analyses. Generally, however, these differences relate to roomblock and plaza terminology. For instance, the East and West Wings often have been called the East and West Roomblocks, whereas the Central Roomblock sometimes has been referred to as the North Roomblock. The reader can familiarize himself with the architectural and spatial terminology at Pueblo Alto by consulting Figures I.2-I.3. Reference to important outlying topographic features and Chacoan sites are covered by Figures I.4-I.6. Finally, a brief description of statistical tests and symbols used in this report was prepared by Wolky Toll in Appendix A.



[a]After Gladwin 1945; Hayes 1981:Figure 10; Judge 1983:Figure 3; Judge et al. 1981:Figure 1; McKenna 1986:Figure 1.2; Toll et al. 1980.

Figure I.1. Various temporal classificatory schemes for the Chacoan Anasazi culture and Pueblo Alto's place within them.[a]

Table I.2. Ceramic typological time in Chaco Canyon: A.D. 900-1300.

Ceramic spans For artifact Analyses	Ceramic spans revised	Phase/Ceramic Period	Dominant painted Ceramic type(s)
A.D. 920-1020	A.D. 900-1040/1050	Early Bonito phase A.D. 900-975± (early Red Mesa)	Red Mesa Black-on-white
		Early Bonito phase A.D. 975±-1040/1050 (Red Mesa)	Red Mesa Black-on-white
A.D. 1020-1040	A.D. 1040/1050	none	Red Mesa Black-on-white and Gallup Black-on-white
A.D. 1020-1120	A.D. 1040/1050-1100	Classic Bonito phase (Gallup)	Gallup Black-on-white
A.D. 1120-1220	A.D. 1100-1140	Late Bonito phase (Late Mix)	Gallup Black-on-white Puerco Black-on-white Chaco-McElmo Black-on-white McElmo Black-on-white (local varieties)
--------------	A.D. 1140-1200?[a]	McElmo phase	McElmo Black-on-white (San Juan variety)
A.D. 1220-1320	A.D. 1200-1300	Mesa Verde phase (Mesa Verde)	Mesa Verde Black-on-white (San Juan and local varieties)

[a]Span is poorly known.

Table I.3. Cross references for reports on cultural material analyzed from Pueblo Alto.[a]

Material	Author	Initial report	Revision	Publication	Computer File Name
Bone tools	J. Miles	1985		Volume III	BONETL2
Human bones	N. Akins	1985		Volume III	none
Unworked bones	N. Akins	1982	1985	Volume III	FAUNANAL
Chipped stones	C. Cameron	1982[b]	new 1985	Volume III	LITHRS, CORE
Chipped stone tools	S. Lekson	1980[b]		Volume III	ARROW, CSDETAIL
Hammerstones	W. Wills	1977[b]		Windes, Volume III	HAMSTONE
Abraders	N. Akins	1980[b]	new 1985	Volume III	ABRADER
Hammerstone/abraders	T. Windes	1987		Volume III	HSABRADE
Manos	C. Cameron	1977[b]	1985[b]	Windes, Volume III	MANOTS, MANO2
Metates	J. Schelberg	1987[b]		Windes, Volume III	METAT3
Ceramics	W. Toll &	1983		Volume III	CERAMRS, FACERAM
Ornaments	F. Mathien	1985		Volume III	none
Roof impressions	E. Ingbar	1977		Volume III	ADOBE
Coprolites	K. Clary	1983[b]	1985	1984[b]	none
Eggshell	T. Windes	1977[b]	1986	Volume III	none
Flotation	M. Toll	1985		1985[b], Volume III	none
Pollen	A. Cully	1983	1985	1985[b]	none
Site inventory	-	-	-	-	INVENTOR

[a]Report is not referenced in bibliography if the title is the same as that published in this volume. Results from the Pueblo Alto analyses were often incorporated in summary articles (see Judge and Schelberg (1984).
[b]Report incorporates analyses of materials from several sites, including Pueblo Alto.

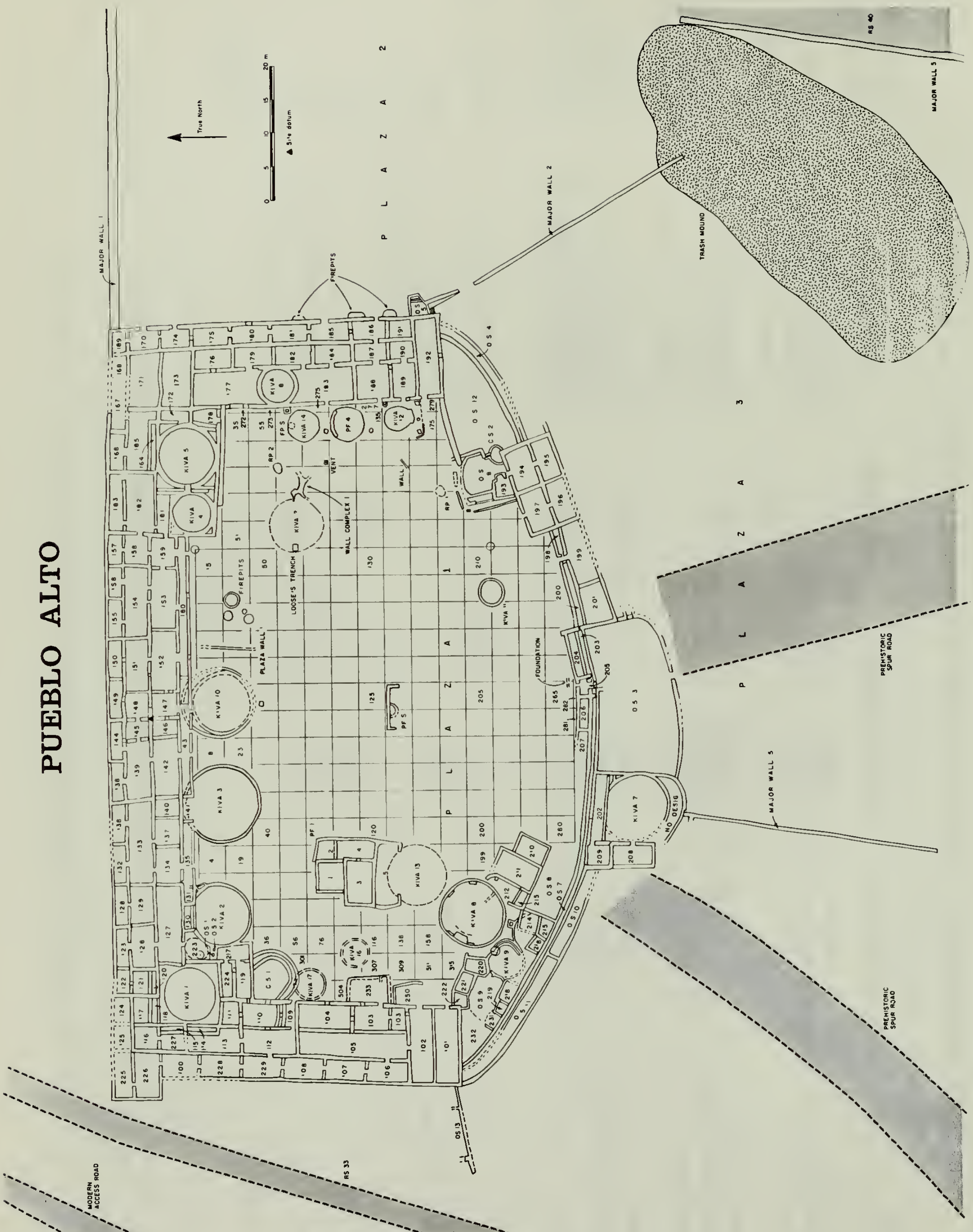


Figure I.2. Pueblo Alto

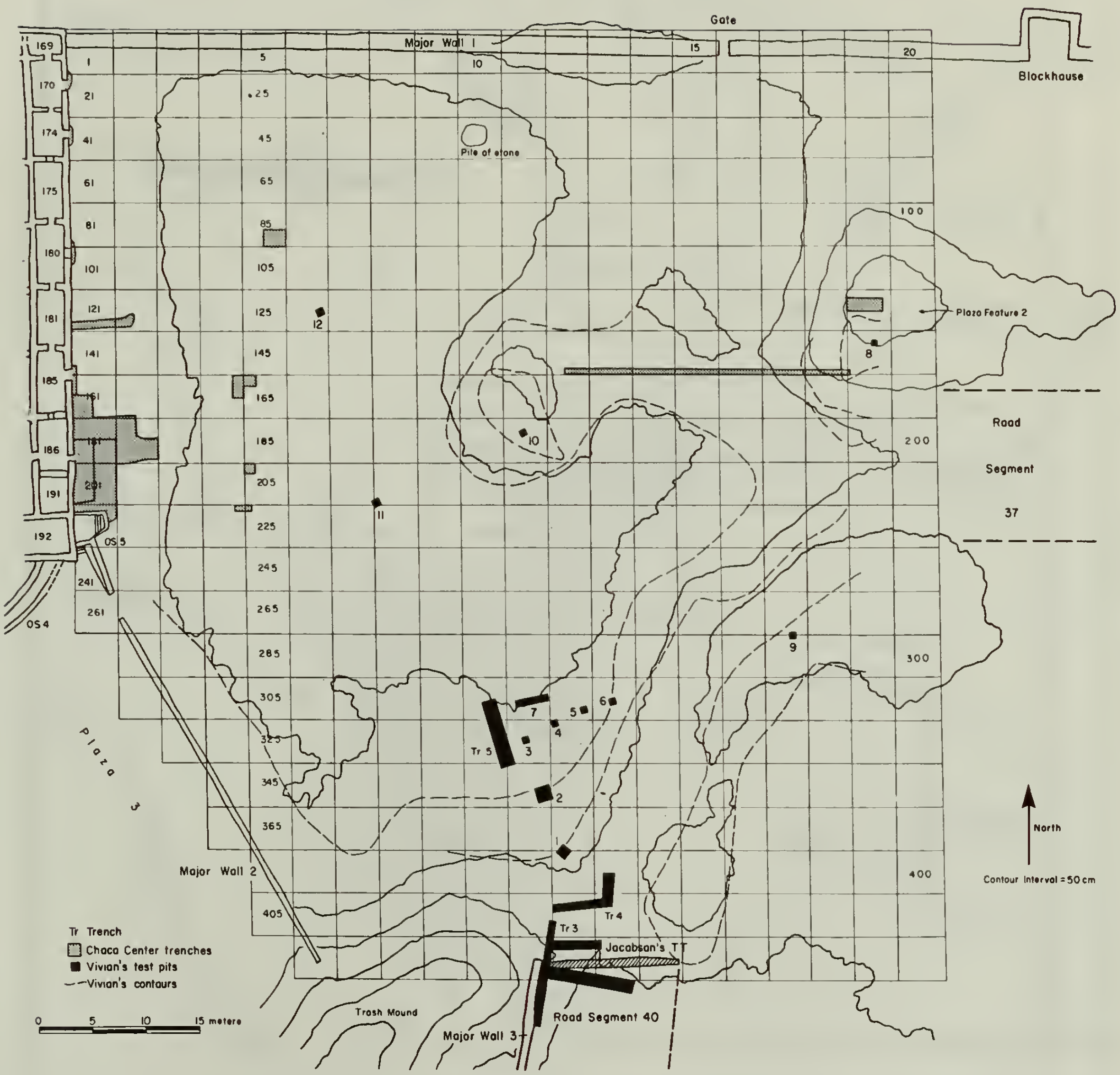


Figure I.3. The Plaza 2 area at Pueblo Alto showing various test locations.

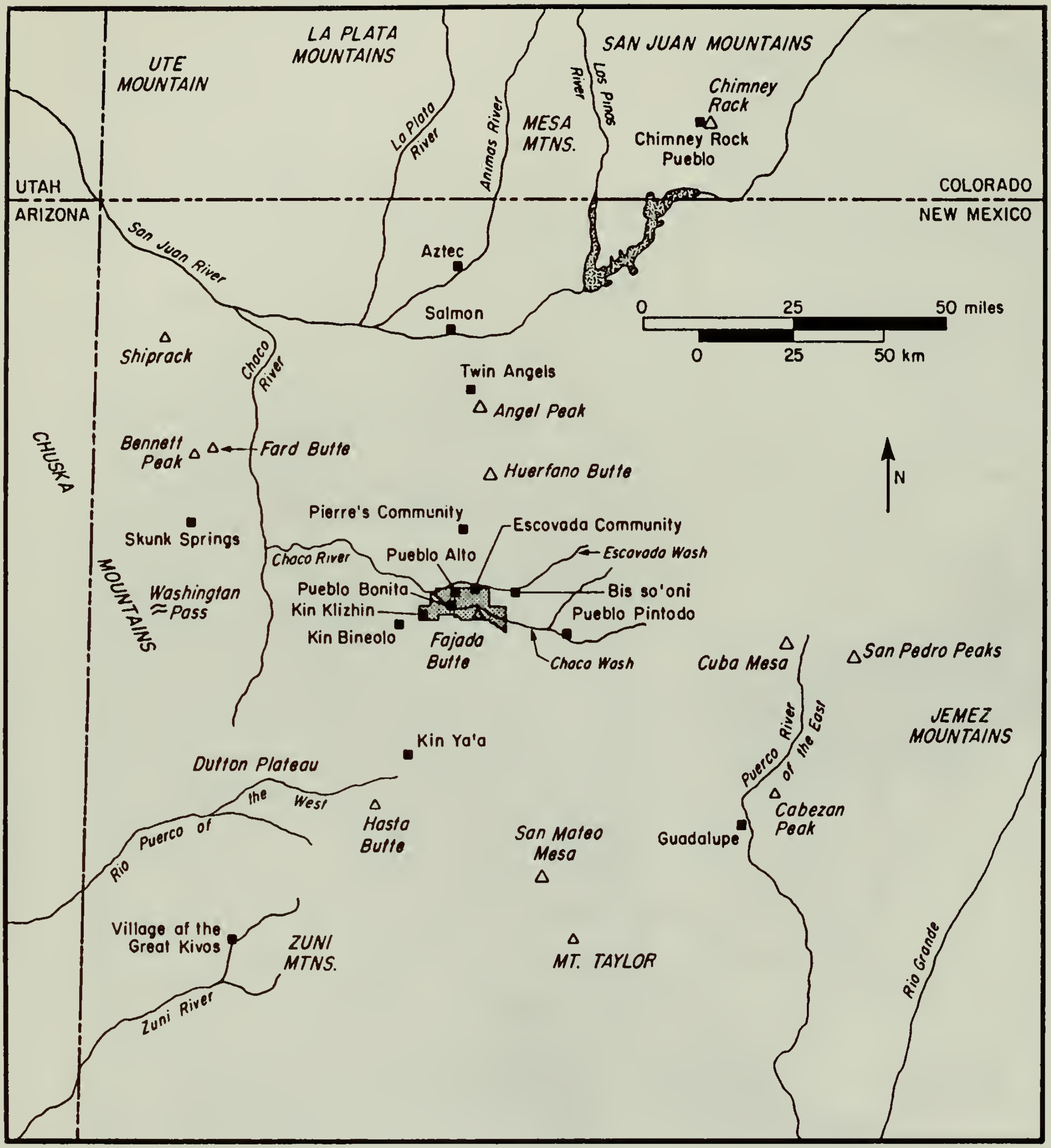


Figure I.4. Some important sites and landmarks in the San Juan Basin and adjacent regions.

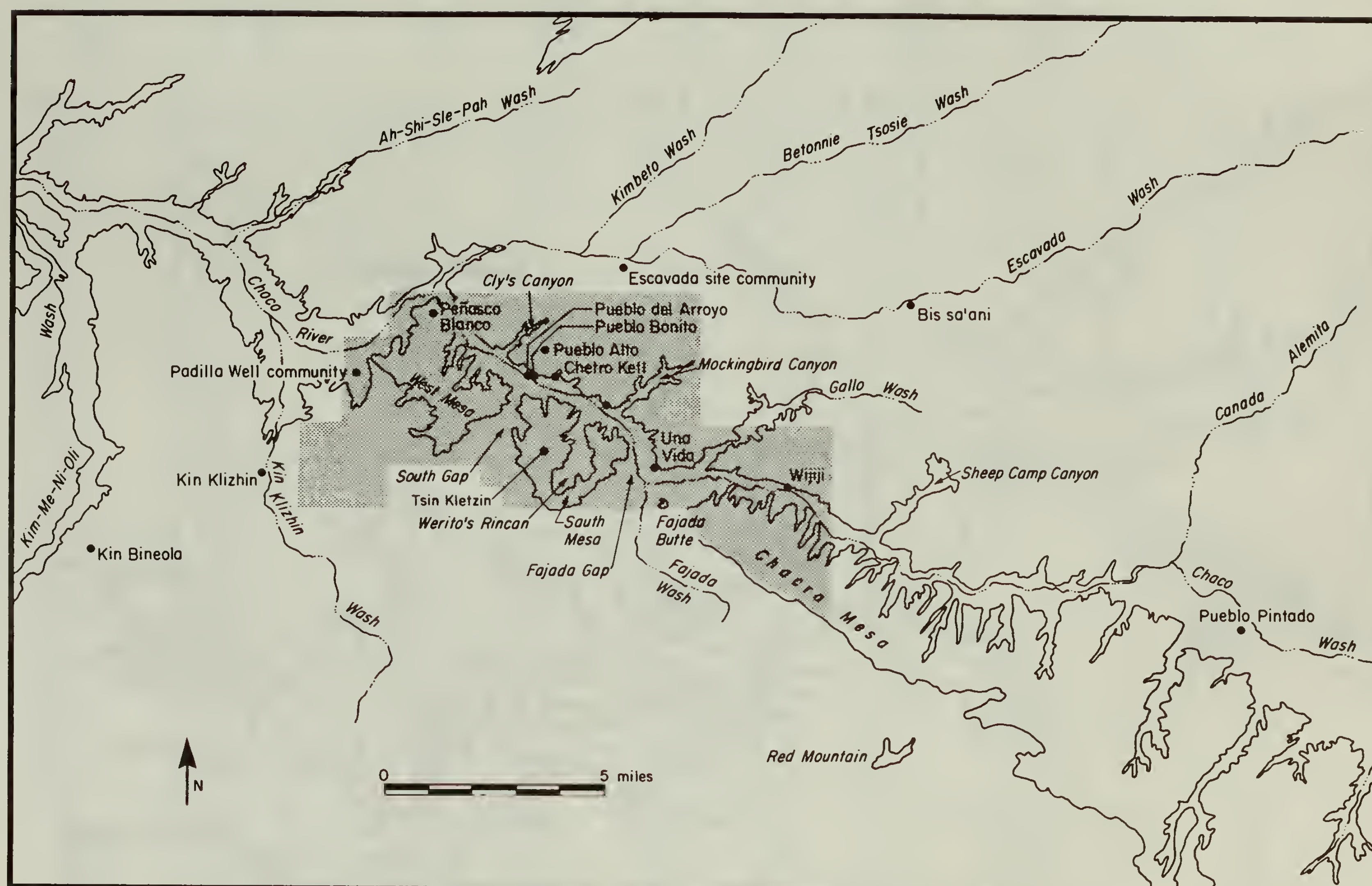


Figure I.5. Important topographic features and greathouse sites in Chaco Canyon and its environs.

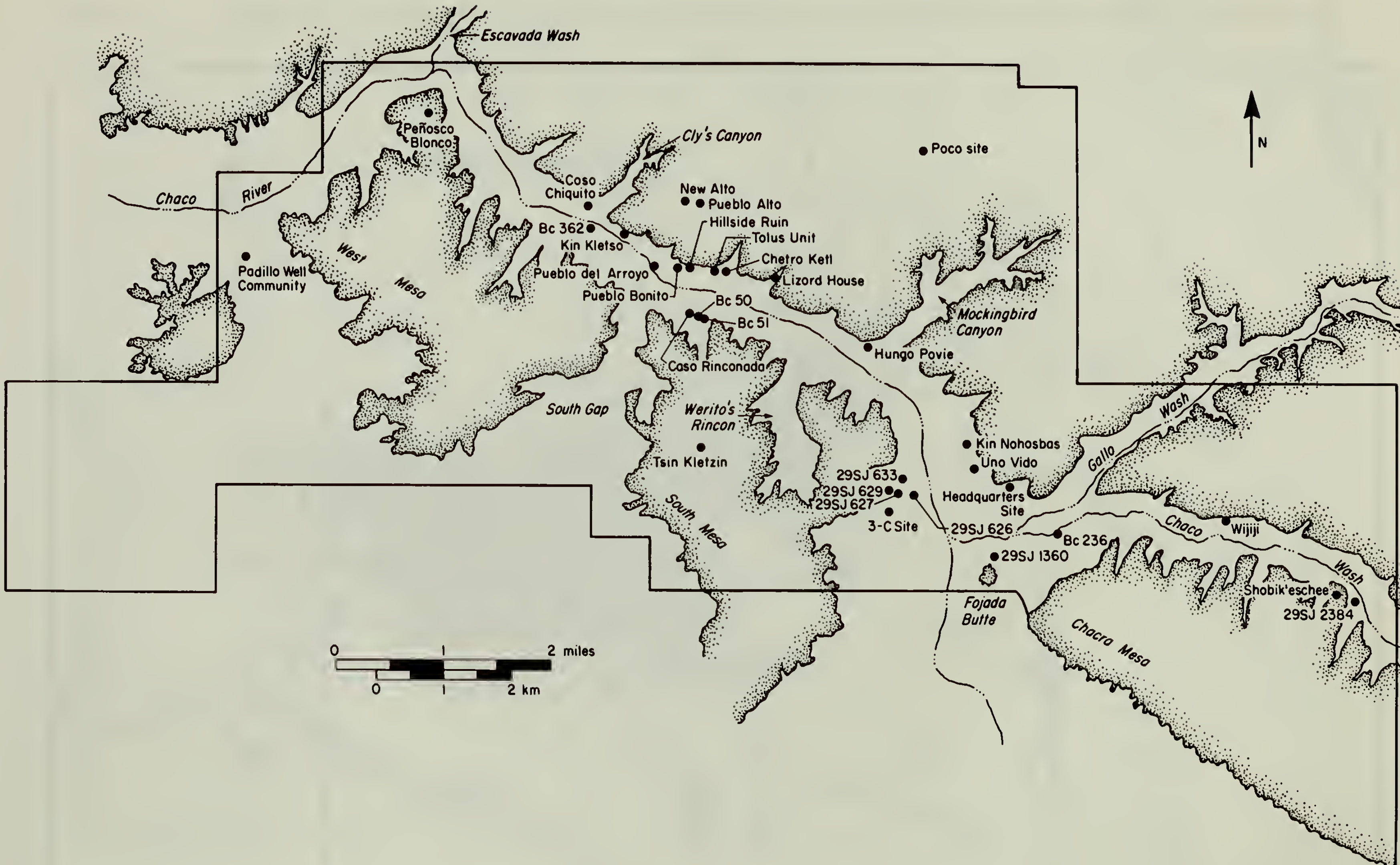


Figure I.6. Important greathouse and small-house sites in Chaco Canyon.

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Chapter One

The Ceramography of Pueblo Alto

H. Wolcott Toll and Peter J. McKenna

Introduction

Many possibilities exist when one approaches a ceramic analysis, and no analysis can cover all ceramics thoroughly. What follows is an attempt to balance as many of those possibilities as seemed feasible and useful. As in the other ceramic reports for Chaco Project sites, the possibilities emphasized for the Pueblo Alto ceramics are: description in a typological framework; discussion of within-site distribution in order to address temporal change and site function; some discussion of ceramic technology and function; and an attempt to assess the quantity of imports to the site through time and its significance.

The Site

Pueblo Alto is one of the large, planned structures for which Chaco became famous, both historically and presumably prehistorically. In barest outline, the site has three temporal components:

(1) An early roomblock, probably with pitstructures; from what little is known of this component it appears to have Red Mesa Black-on-white as the main decorated type, with little representation of preceding types and no evidence of Gallup Black-on-white, the succeeding main type. Structures from this component were completely built over by the next component sometime in the early A.D. 1000s.

(2) The second component accounts for the part of the site that puts Pueblo Alto into the "greathouse" category. In the brief period of about A.D. 1030 to 1100 the 100-plus-room, six-kiva (?), core-and-veneer-masonry roomblock with large central plaza was constructed. The 4-m-high extramural Trash Mound, begun during the preceding component, was deposited and discontinued. Corrugated graywares and Gallup Black-on-white are the dominant ceramic types associated with this component.

(3) The final component seems to be characterized architecturally by what might be called add-ons to the main roomblock, including small irregular rooms in the southwestern part of the central plaza, perhaps the Plaza Feature rooms, some of the "other structures" and the "circular structure," and perhaps the arc enclosing the central plaza. Decorated pottery of this period is largely carbon-painted, including Chaco McElmo Black-on-white, while White Mountain Redwares replace San Juan Redwares. This component is thought to have lasted from around A.D. 1100 to 1170.

Excavations

The Chaco Project conducted excavations of a fairly small percentage of this large site. Of the three components outlined above, the least is known about the first, and it is least represented by ceramics. In terms of knowledge of Canyon-wide ceramics this is of little concern because the Red Mesa period is the best represented ceramic segment in the project's collections: it is the dominant decorated type at the small sites 29SJ 627, 29SJ 629, and 29SJ 1360. Sufficient ceramics were recovered from this component at Pueblo Alto to allow comparison with small sites, but more would be useful, as would more knowledge of the size of the earliest roomblock. Excavated proveniences from this component are a pit of unknown size in the main plaza (presumably a pitstructure), portions of two rooms with associated extramural surfaces under the North Roomblock, the earliest portion of the Trash Mound, and the earliest West Roomblock floors.

The "classic" or Gallup portion of the site yielded by far the most material from Pueblo Alto. The main reason for this preponderance is the Trash Mound--the test placed in this feature is volumetrically a small percentage of the mound's total, but had a large volume of high-artifact-density trash relative to the rest of the excavations. Other excavated proveniences from this component are a portion of a kiva in the plaza (Kiva 13), and the intermediate floors in excavated rooms in both North and West Roomblocks.

Boundaries between the last two periods are hard to define in rooms, but archeomagnetic dates and ceramics suggest that the uppermost floors belong to the last component. The Plaza Feature rooms and a kiva-in-a-room in the West Roomblock are also likely a part of this component. Ceramically, these contexts are of little concern because so few sherds were recovered from them. Two trash-filled kivas contain material from this component, both in the central plaza: Kiva 10 and Kiva 16. Neither of these features was excavated to the floor, but both provided substantial quantities of material, in particular Kiva 10. In addition, the plaza surfaces and wall-clearing proveniences that provided material in any quantity are from this component.

The initial phase of Chaco Project excavations at Pueblo Alto was to clear wall tops of the entire site to obtain a reliable site map. This procedure, of course, recovered materials. The Main Roomblock rooms are characterized by depths of several meters, and those excavated followed a

general fill pattern of a layer of concentrated wall rubble overlying a layer of aeolian sand above the top floor. Most of the wall-clearing material, as well as the room fill, then, comes from postoccupational debris. The rooms excavated contained relatively little in the way of in situ ceramics. The ceramics chosen for the focus of the detailed analysis, then, are from the several major trash proveniences, and those from wall clearing and room fill are disregarded.

Analysis

This is not to say that the ceramics from other proveniences have been completely ignored. As described in greater detail below, all ceramics were processed through a rough sort inventory (see the Ceramic Sample below). This procedure was carried out by T.C. Windes and P.J. McKenna following each excavation season in 1976 through 1979. In 1979 a group of carbon-painted sherds from Kiva 10 was processed in detail and refired as part of a limited analysis for a paper included in a volume on ceramic exchange (Toll et al. 1980). In the next phase McKenna recorded detailed attributes of the sample drawn during the rough sort, in late 1979 and early 1980. Then, from May to July 1980 and again in early 1981, Toll did a dissecting-microscope paste analysis. Following key punching, preliminary computer runs and analysis were carried out in 1980 and 1981, the results of which appear in another ceramic exchange volume (Toll 1981). Beginning in early 1982, numerous computer runs on the Pueblo Alto data were made, and in April, following completion of the Site 29SJ 627 report (see reference below), Toll began compilation and write-up of the material, which continued until February 1983. While Toll did the computer work and most of the writing and other mechanics, McKenna provided some pages on types' surface treatment, an appendix on matches, organization of tables from other reports, multiple readings of various sections for content, and, of course, all the basic coding of surface attributes.

Terminology

There are a number of commonly used terms and concepts in this section that need some clarification. This section concerns primarily the ceramics found at Pueblo Alto, but they are more meaningful and more easily discussed in terms of ceramics from other Chaco Project excavations. To save space and patience, bibliographic references for these sites are omitted and sites are referenced by their number only. References and site designations are as follows:

Smithsonian Number	Name in Text	Site Reference	Ceramic Reference
29SJ 627	same	Truell 1980	Primary: Toll and McKenna 1982 Secondary: Toll 1981, 1983 Toll et al. 1980 Warren 1977

29SJ 628	same	Truell 1975	Primary: Toll and McKenna 1980 Secondary: Warren 1976
29SJ 629	same	Windes 1978a	Primary: Toll and McKenna 1981 Secondary: Toll 1983
29SJ 633	same	Truell 1979	Primary: Secondary: Toll et al. 1980
29SJ 1360	same	McKenna 1984	McKenna and Toll 1984
29SJ 389	Alto Pueblo Alto	Windes 1987: this report Volumes I, II	Primary: this report Secondary: Toll et al. 1980 Toll 1981, 1983

To this list should be added the projected ceramics chapter of the artifact volume, to be written by McKenna and Toll, which is planned to give an overview of all ceramics analyzed by the project. It is useful for the reader to know that the sequence of final analysis and write-up is 29SJ 628, 29SJ 629, 29SJ 627 with Shabik'eshchee concurrent, 29SJ 1360 overlapped both 29SJ 627 and Pueblo Alto, and, finally, the projected overview.

All of the small sites overlap with Pueblo Alto in terms of ceramic types present and, to some degree, in real years. The sample from 29SJ 633 is on the whole later than much of Pueblo Alto and some of it post-dates occupation of Alto. Site 29SJ 627 provides the largest group of sherds that is contemporary with the greatest activity at the towns, considered here to be A.D. 1040-1100; the bulk of material from 29SJ 627, however, dates to pre-A.D. 1040 and the post-A.D. 1040 occupation may be sporadic (Truell 1980). Both 29SJ 1360 and 29SJ 629 date largely to pre-A.D. 1040, with some minimal later overlay.

There are several ceramic terms that are subject to variable usage. The first is "ware." In Colton and Hargrave's (1937) system wares are assigned to such areas as Cibola White Ware or Tsegi Orange Ware. Some use is made of the ware concept in this sense (see Type Description below), but, in general, the present usage is more inclusive. Thus, here grayware, whiteware, redware, and polished smudged ware cover major ceramic subsets easily distinguished in almost all cases by means of surface color and texture. Subdivision into carbon-painted (C/w) and mineral-painted (M/w) whitewares is also made; some of this may be an infraction of ceramics rules, but does not seem to be confusing.

The Chaco Project ceramic analysis uses the type concept in a very conventional way. Types are regarded as clusters of attributes such as design, surface treatment, paint type, and temper which conform within tolerances to defined constellations. Type identifications emphasize different attributes for different types, and, of course, placement questions are routine. Typological assignments are regarded as useful for placing ceramics within a general space and time of manufacture. In this analysis, however, types are not regarded as immutable monoliths--subvariation

is a major key to regional and temporal processes and is at least as important as the simple occurrence of the types themselves. Subvariation in typological, temporal, and spatial units is monitored through the occurrence of various technological, functional, and stylistic attributes. It is useful to both subdivide classificatory units and to combine them, depending on the analytical context.

Temper names seem to have a history of confusion and variability, and we have, unfortunately, not escaped either the terminological confusion or the insecurity it symptomizes. The distinctive, igneous, tempering material from the Chuska Mountains is very important to this report and has had many names, including dark rock, sanidine basalt, melatrachyte, trachybasalt, and trachyte (see Loose 1977:567-569). Shepard (1956, 1963) and Windes (1977) use "sanidine basalt"; the Dolores Project and, for a time, this project called it "trachybasalt." However, the term with the greatest currency at this time seems to be trachyte (Garrett and Franklin 1982; Loose 1977; Warren 1967, 1977). "Trachyte" also has the considerable fringe benefits of being short and pronounceable and is, therefore, the term in use here.

Quartz sand grains are one of the most--if not the most--commonly observed temper constituents in pottery from Chaco. The origin of this temper is, therefore, of considerable interest to ceramicists. Warren's analyses (1976, 1977) of pottery from the region led her to the conclusion that such sand is invariably from crushed sandstone. She did some groundwork on criteria for distinguishing geological sandstone formations in pottery temper. Because the geology of the San Juan Basin is virtually all sedimentary (see Dane and Bachman 1965), microscopic knowledge of the Basin's sandstone formations is essentially an infinite task. Because Toll did not have confidence in his identifications of most formations, this analysis recorded only a few varieties of sandstone and the grain size of all items. As a matter of opinion, excluding all free sand as temper seems unrealistic; however, for the most part we have followed Warren's lead and refer to "sandstone" for pottery with quartz sand grains in it. References to "sand" do not indicate a category separate from "undifferentiated sandstone."

Types and Time and Types of Time

Elapsed time is, of course, critically important to studies of change and site-to-site differences. Dates and time periods recur throughout this report, but, if years are the currency of archeology, these are on a floating valuation system, or are in some cases just plain funny money. Time may be established in several ways, each somewhat different.

(1) Chronological time deals in real years, pinpointed in archeology with "absolute dating techniques." Pueblo Alto is one of the most extensively archeomagnetically sampled sites in the Southwest, but many of the dates obtained are suspect (too late), and none can be used to date ceramics with precision. Pueblo Alto also has the frustrating aspect that, despite the abundance of dated wood specimens, the provenience distribu-

tion is limited, and therefore datable ceramic associations are extremely limited. What "real" dates are available do not contradict our assigned dates, but no increases in chronological precision based on real years are now possible.

(2) Depositional time relies on the law of superposition and on principles of seriation. Thus, within a deposit items are generally older if they are deeper, barring disturbance, and, ever since Sir Flinders Petrie, archeologists have been ranking deposits through overlapping materials, usually ceramics. On the whole, depositional time works, but it is also evident that vessel life was variable and that fragments of vessels could be in circulation as tools after their demise as pots. In addition to variable vessel life, different deposits have very different durations of accumulation. We are fortunate at Pueblo Alto in having a number of deposits which are both spatially and temporally discrete, and yet which appear to span the occupation of the site with few gaps. While there are differences in volume and time span of deposits, it is possible to realistically regard them as a series and to compare them as temporal events.

(3) Typological time is based on the fact that most types do have chronological limits, and that types appeared more or less in a serial fashion. Characteristics of typological time that relate to our use of the concept as an ordering principle are the following:

(a) Although points along the typological time line have the appearance of intervals, they are ordinal at best; certainly, typological time cannot be thought of as consisting of equal-sized units, though it can be given a rough correspondence to years.

(b) The ordinal nature of typological time is also not perfect--that is, rather than types ending and beginning at precise points, there is temporal overlap between them (see Figures 1.1 to 1.3; or Breternitz et al. 1974:Table 1). The concept, therefore, relies on the probability of a type coming from a certain point in time as suggested by the classic "battleship curve" (Deetz 1967).

Thus, typological time deals strictly in trends and tendencies, relying on one type being generally later than another, and should be regarded in that light rather than as an absolute chronology or perfect series. As such, its use allows the defining of trends in attribute changes such as decoration, temper, vessel size, and use. This is nothing more than the well-established use of ceramics for chronological placement of deposits, with an attempt to use that chronological information and at the same time recognize its limitations.

Typological time's connection with chronology is one of cumulative experience as embodied in Breternitz (1966) and subsequent refinements. Windes (1984, 1985) has been refining ceramic groups for Chaco for some time, and the Pueblo Alto deposits are useful for such refinements because of their discrete and unmixed nature. Using dates for particular types and working with these discrete deposits, it is possible to feel that one

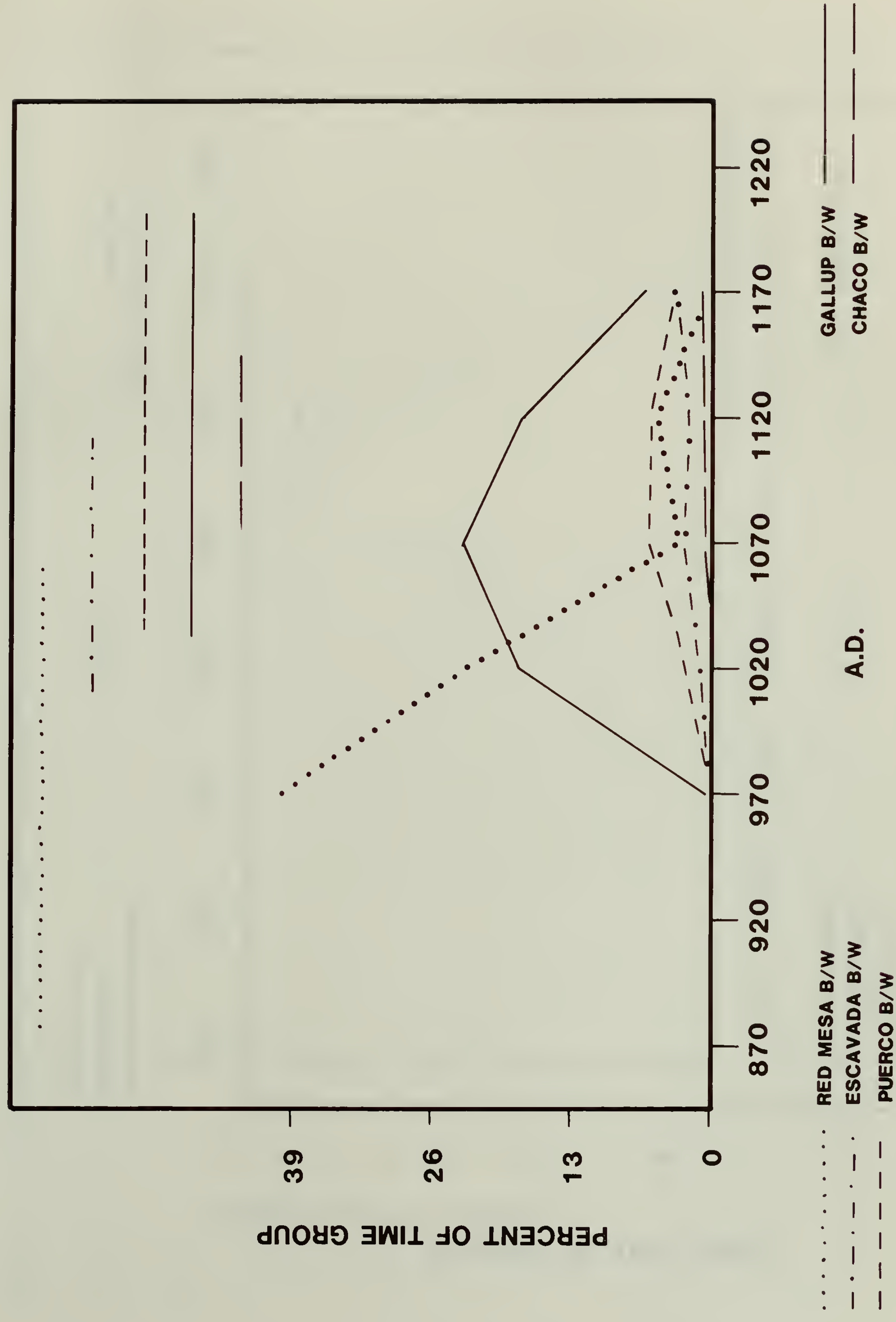


Figure 1.1. Chronology and occurrence of primary mineral-on-white types found at Pueblo Alto.

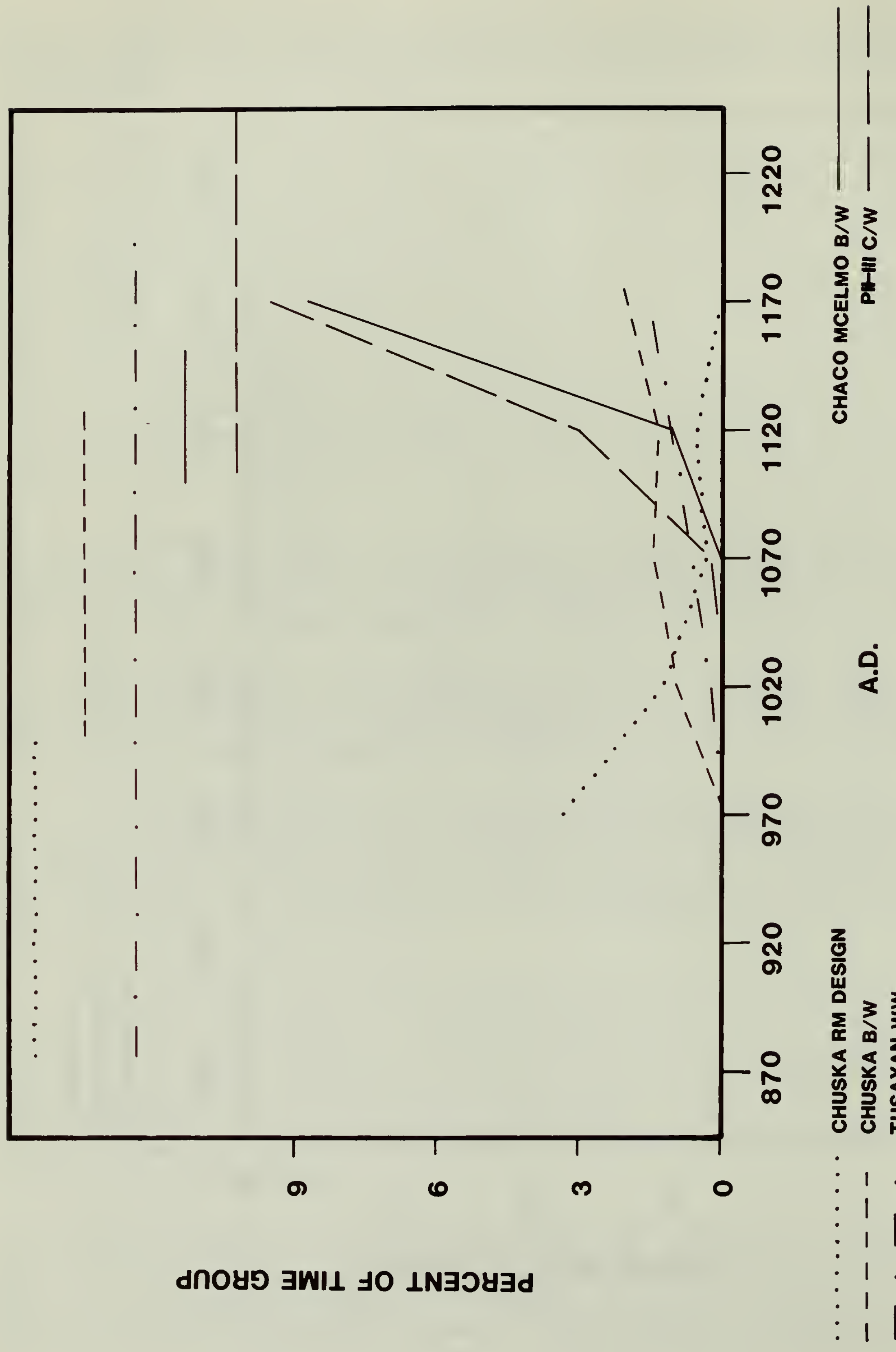


Figure 1.2. Chronology and occurrence of primary carbon-on-white types found at Pueblo Alto.

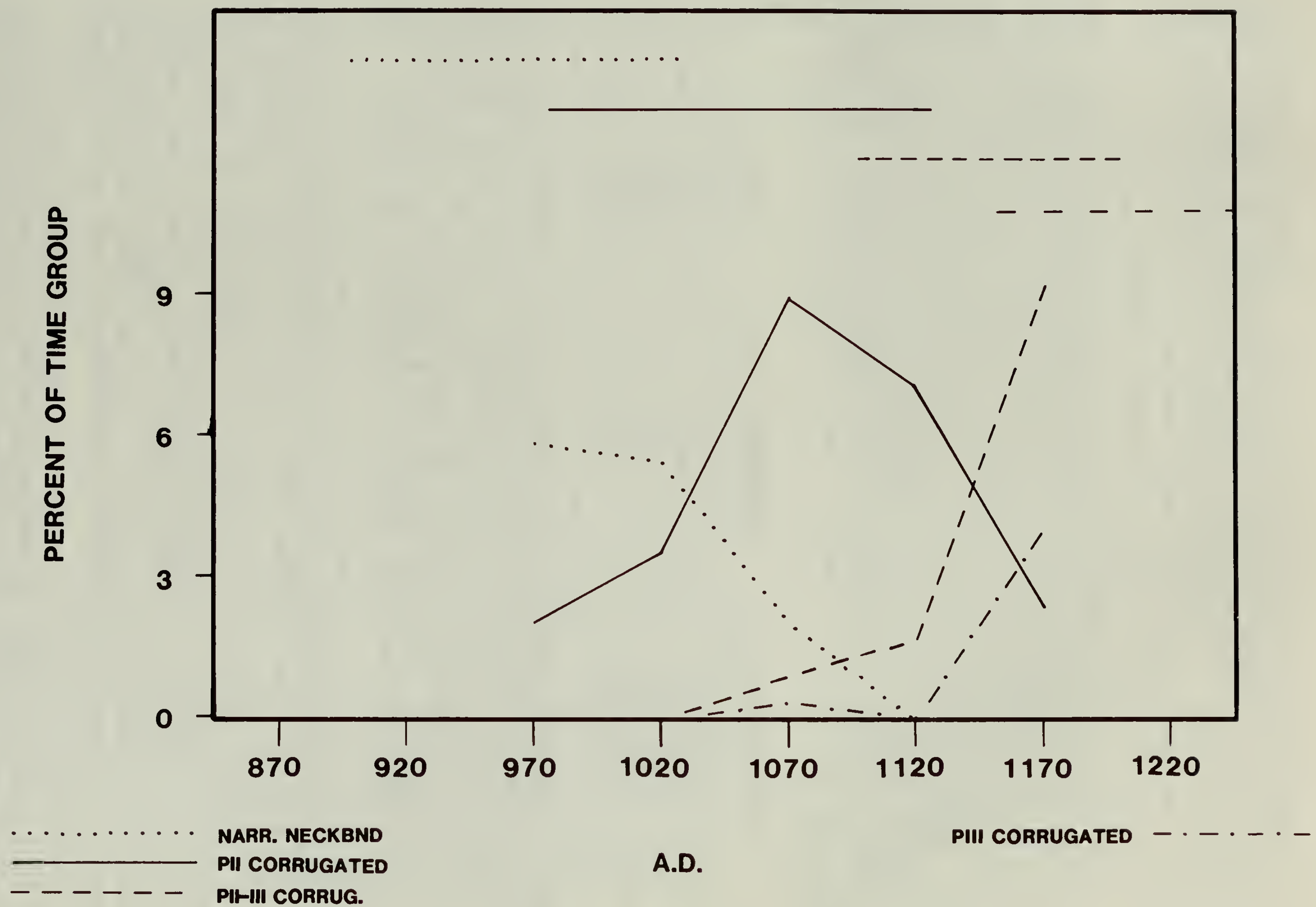


Figure 1.3. Chronology and occurrence of primary grayware types found at Pueblo Alto.

is fine-tuning deposit dates in terms of years. Yet, as noted, absolute dates are in short supply, so some of these adjustments expressed in years are somewhat fictional (or at least hearsay starting from a "date" at some typological remove). Cumulative experience is sufficient to validate sequences and groups, and these remain constant--the date labels assigned to the groups are the most recent, best-guess estimate.

Figures 1.1 to 1.3 show the occurrence of the more abundant types at Pueblo Alto as compared to the estimated production span for each type. These figures are based on a number of assumptions, and those assumptions, as well as the characteristics of groups used to generate Figures 1.1 to 1.3, are explored in detail in subsequent sections. The broadest assumptions concern the date assignments and their representation on the figures. Dates for the time groups were assigned by Windes using visual assessments of the ceramic type assemblages in various proveniences (see Time-Space Analysis). Because it is necessary to represent segments of many years as points, and because the time segments are not all equal in length, some distortion is present. Most of the points are midpoints of time groups:

Time Group (A.D.)	Graph Point (A.D.)	Sherd n
920-1020	970	238
1020-1040	1020	308
1020-1120	1070	3,668
1020-1220	1120	352
1120-1220	1170	803

Except for the A.D. 1020-1040 group these work out remarkably well, both numerically and subjectively vis-a-vis ceramics. It is a questionable procedure to include the A.D. 1020-1220 group, but it has been found that this group is likely to be on the whole later than the A.D. 1020-1120 group, which the figures illustrate, as most trends pass through the A.D. 1120 point smoothly. That the group is a mixed one is evident in the slight increases in Red Mesa and narrow neckbanded at the A.D. 1120 point.

Note that the percentage scales, for the carbon-on-white and grayware figures, are the same (maximum value near 10 percent) but that the mineral-on-white scale goes much higher (maximum value around 40 percent). Several aspects of the Pueblo Alto ceramics are at play here. Unidentified corrugated (not shown) is 22 percent of the entire sample. Graywares are abundant at Pueblo Alto relative to other sites, particularly in the A.D. 1020-1120 time segment, so changes in frequency are probably both temporal and functional. The low carbon paint frequency, however, is representative--as the figure shows, most of the carbon-painted ceramics occur late.

The production spans come from Windes (1977, 1984) for the Chuska and Cibola white and graywares with supplemental information from Breternitz et al. (1974) for PII-III Carbon-on-white. The Tusayan Carbon-on-white is primarily Black Mesa Black-on-white, which is broadly dated A.D. 875-1130

by Breternitz (1966:70), with minor amounts of Sosi Black-on-white, dated A.D. 1075-1200 (Breternitz 1966:96). This combination of approximate production spans and center points for approximate time segments means that some beginnings do not match precisely, which lends a nice touch of realism to the figures.

The complementariness and noncongruence of depositional time and typological time are also illustrated by Figures 1.1-1.3. Assumed production dates of the most abundant specific types at Pueblo Alto are at the top of each figure, and actual frequencies found within assigned time periods are below. The time periods were assigned mainly on the basis of ceramic types and, secondarily, on architectural types and chronometric dates. The figures show that in all cases the types were found in time-group proveniences falling outside the dates assigned to the type. Mixing may be blamed in part, but imprecision of dates and type assignment and differential deposition are all further complications lurking in the background. On the positive side, actual frequencies do conform to the trends predicted by the assigned dates.

The Report

Briefly, this undertaking proceeds as follows. The first section provides an overview of all the ceramics from the site and discusses how and why the detailed analysis sample was drawn from that group. The nature of the sample as compared to the whole collection is also examined. An extensive, quantified description of the most abundant grayware and whiteware types (referred to as "primary types") found at Pueblo Alto follows. As a part of this discussion, within-type groups based on temper and surface attributes are compared to explore the possibility of identifying production groups. Next, ceramic attribute associations are examined, and project-wide, time-space groupings made. This section is followed by a more detailed examination of the Trash Mound and Kiva 10, with a summary and synthesis of temporal change in the ceramics at the site. Covariation of several main technological attributes and functional interpretation constitute the next-to-last section. Although all sections contain interpretive material, the final section draws on the preceding, more cautious and data-oriented sections to make somewhat broader and more speculative statements regarding ceramic evidence for import and social relationships.

The Ceramic Sample

Method and Rationale

Any archeological collection of ceramics is automatically subject to a number of conditions that affect the interpretability of the assemblage. Essentially, these conditions are a series of samplings on samples, only some of which can be controlled, and, when controllable, are only partially so. As discussed by Orton (1980:161-167), meaningful quantification is

greatly complicated by these various samplings. Differential breakage and distribution of vessel parts, partial vessel recycling, disturbance of deposits, partial excavation of deposits, and incomplete recovery of artifacts in excavated deposits all directly affect the ceramic sample before the analysis begins. In order to recognize these problems as fully as possible, the Chaco Project analysis passed the ceramic assemblage through two main stages:

(1) Following washing, all the ceramics from a site were tallied on coding sheets with provenience information in groups of "rough sort types" and basic vessel-form categories. This procedure was designed to provide an inventory of ceramics as rapidly as possible without undue agonizing over typological assignments. This tally is referred to in this report as the "rough sort", raw counts, and bulk counts. There is some further manipulation of these counts--categories including exotic types (redwares, carbon-on-white, exotic mineral-on-white, polished smudged) are placed in more specific groups, and the whole serves as an inventory used by Windes in assigning ceramic dates to proveniences (see Appendix MF-E in Volume II of this report).

(2) The next stage generates the ceramic collection on which this report is based. As a part of the rough sort, two procedures basic to the second stage of analysis were carried out. The first of these was to identify sherds coming from the same vessel. Matching sherds has three benefits: it reduces redundancy of the sample (in which a vessel is recorded as many times as a piece of it occurs), it increases the data available for a given vessel (more design visibility, variability of paste, more reliable diameter estimate, for example), and, especially when a vessel is found in a number of proveniences, it gives information as to mixing and contemporaneity of deposits.

Although the matching program was done for whole site collections at the smaller sites, it was done by area for Pueblo Alto. Thus, no attempt was made to match sherds from the Trash Mound to those from Kiva 10 or from the rooms. There is some chronological basis for this, but it is conceivable--though in most cases unlikely--that some cross-area matches exist. A feature of the matching procedure that is neither quantifiable nor replicable but is an important aspect of it is that P.J. McKenna has a truly remarkable "pottery sense" and memory, which allows him to recognize fragments of the same vessel even if the rest of the vessel is somewhere else entirely--this asset improves the quality of the matching from Pueblo Alto and other sites on which he has worked a great deal.

The second procedure is to draw rim sherds from the bulk collection to form the second-phase sample. The second phase--referred to herein interchangeably as final analysis and detailed analysis--is not composed strictly of rim sherds. Closed forms such as canteens, jars, and ollas usually have designs on their rims that are unrelated to those on the vessel body. For that reason and because of the very small rims on such jars, larger, closed-form body sherds were also drawn for the final analysis. Because such sherds are difficult to match to rims, the risk of duplication is somewhat increased by this practice, but the increased

design information was deemed worth the risk. Within-type duplication of a vessel is less likely than placement of a body sherd in a specific type (such as Red Mesa) and a small portion of rim in a generic type (usually PII-III mineral-on-white).

Thus, another level of sampling has been added to a complex situation. One might ask: why make things even more complicated? There are two primary reasons. First, the combination of matching and rim sampling (and continal alertness for further matches) gives a collection that is more meaningfully quantified than bulk counts because it strives to deal in units that have cultural meaning: vessels. Sherds, on the other hand, have a far vaguer meaning as vessels differ greatly in size and breakage. Second, this procedure has the pragmatic benefit that the collection is reduced to a size that can be put through the detailed analysis. We suffer no delusion that no vessel is represented in the sample more than once nor that every vessel of which any part was encountered in our excavations is represented in the final analysis. We claim only that sufficient control has been exercised that quantification of the sample approximates vessels. Although some necessary tabular information is included with this text, the reader who seeks more detailed tables should consult the microfiche tables (MF-1.1 to MF-1.46) for this report.

The detailed analysis as conducted had two subphases--McKenna recorded surface attributes such as paint, slip, design, orifice, and type (see for example Tables 1.1 and MF-1.1). Toll then examined each piece with a 30-45x binocular microscope for paste attributes such as grain size, sherd temper, and temper type (see Table MF-1.2).

As explained below, some further sampling was performed for the portion examined microscopically. The final analysis, therefore, has three subsets: the full quantity, the portion thereof that has temper information, and the portion that are true rim sherds. Because of the jar body-neck problem, the rim segment is probably the most reliable for viewing vessel form assemblages, but, generally, the temper and whole sample were used in the analyses.

Sample Composition and Within-Site Source

The Pueblo Alto ceramic sample components follow a pattern seen at 29SJ 627 and 29SJ 629: the majority of the raw sherd counts are grayware, but the majority of the more controlled rim, temper, and detailed samples are whiteware. As is discussed in those reports, this results from the likely higher ratio of sherds per vessel among graywares. With matching and rim sampling as controls for vessel duplication, the proportions shift toward a better representation of the actual ceramics present in terms of vessel count instead of a measurement of the sheer volume of sherds recovered. The degree to which the Pueblo Alto sample follows that trend is less marked than it is at the other sites, however. Whereas there is a difference between the grayware percentages of the rough sort and of the rim sample of from 35-45 percent at 29SJ 627 and 29SJ 629, the difference

Table 1.1. Pueblo Alto Red Mesa Black-on-white designs constituting more than 2% of total inventory.

Designs	Motif Number 1	2	3	n	% of total
parallel lines	24	12	3	39	8.1
pendant parallel lines	12	7		19	4.0
scrolls	7	21	2	30	6.3
dotted lines	9	9	4	22	4.6
checkerboard	9	2		11	2.3
sawteeth	9	13		22	4.6
narrow Sosi style	16	7		23	4.8
solid band design	91	8	2	101	21.1
general solids	14	7	1	22	4.6
hatchure A-1	24	3		27	5.6
solid ticked triangles	37	18	1	56	11.7
squiggle lines	10	2	2	14	2.9
interlocked ticking	10	3		13	2.7
Total 2% designs	277	112	15	399	83.3
Total	314	144	21	479	
n w/ 1,2,3 designs	170	123	21	314	
% w/ 1,2,3 designs	54.1	39.2	6.7		

in the Pueblo Alto collection is only 18 percent. Most of the rim sample-rough sort discrepancy is due to an increase in whiteware counts at each site, though the differences are 2-4 percent less than the grayware differences. The Pueblo Alto samples contain notably higher percentages of redwares and polished smudged wares than do the small-site samples.

The differences in composition of these three sites' sample variants raise some epistemological questions that must be addressed before launching into interpretations on either the within-site or across-site level. It would be naive to claim that each site's sample was drawn in precisely the same way--the sample pulling was done at different times by two different people under differing conditions and expectations. Further, excavation strategies differed from site to site, so that before the selection process even began there were some differences.

Bulk Versis Detailed Sample Comparisons

The detailed analysis sample from Pueblo Alto was not drawn from the entire bulk collection. The Alto sample was the last sample drawn, and its selection was influenced by increasing anxiety over the size of the analytical task. Therefore, the ceramic sample was drawn only from the nicely isolated proveniences containing numerous sherds. The idea at the time was that proveniences with few sherds, often mostly from wall-top clearing or upper rubble fill, were subject to additional depositional ambiguities. On the other hand, the few occupational deposits (such as Rooms 103 and 110) and spatially and temporally isolated trash deposits were more reliable and more relevant to behavioral information.

Tables 1.2, 1.3, and MF-1.3 summarize ceramic distribution on the site and show which proveniences contributed how much to the detailed sample (provenience information for the bulk sample may be found in detail in Appendix MF-E for Volume II of this report). Ware-groups in the tables are composed of the following types:

Early Grayware--Lino Gray, wide neckbanded, narrow neckbanded, neck corrugated, and all plain gray

Late Grayware--PII, PII-III, and PIII corrugated, and all unidentified corrugated

Early Mineral-on-white--BMIII-PI polished and unpolished mineral, Early Red Mesa, and Red Mesa Black-on-white

Late Mineral-on-white--Escavada, Puerco, Gallup, Chaco Black-on-white, and PII-III mineral

Early Carbon-on-white--BMIII-PI polished and unpolished carbon and Chuska carbon with Red Mesa design

Table 1.2. Bulk ceramic contents of Pueblo Alto proveniences.

	WARE GROUPS										
Provenience	Early Grayware	Late Grayware	Early Mineral/w	Late Mineral/w	Exotic Mineral	Early Carbon/w	Late Carbon/w	White-ware	Polished Smudged	Redware	Total
West Wing											
Room 103	84	988	40	428	2	4	77	155	30	146	1954
Room 109	21	175	11	167	0	1	20	69	0	3	467
Room 110	205	1,924	78	587	18	11	118	226	89	25	3281
Room 112	229	266	72	254	1	4	16	108	13	19	982
Room 229	33	369	12	96	11	0	9	48	0	2	580
Unexcavated[a]	6	13	7	22	1	0	4	15	1	1	70
Total	578	3,735	220	1,554	33	20	244	621	133	196	7,334
North Wing											
Room 50	20	2	5	9	2	2	3	8	1	1	53
Room 51	11	0	4	0	0	0	0	4	1	0	20
Room 138	41	14	8	20	0	1	10	17	2	1	114
Room 139	35	74	27	81	0	0	9	38	2	6	272
Room 142	592	430	124	178	2	20	148	215	14	6	1,729
Room 143	137	762	39	246	6	1	120	114	12	13	1,450
Room 145	174	219	144	149	0	10	26	72	24	15	833
Room 146	353	218	73	130	3	1	124	188	14	4	1,110
Room 147	22	587	8	199	6	0	74	89	18	6	1,009
Room 236	7	5	0	12	0	0	0	4	3	0	31
Unexcavated[a]	6	58	3	25	2	1	4	6	0	2	107
Total	1,398	2,369	435	1,049	21	38	518	755	91	54	6,728
NE Unit[a]	1	19	1	27	0	0	10	5	1	4	68
East Wing[a]	7	26	6	51	1	0	10	25	0	1	127
SE Arc[a]	50	306	30	278	2	1	67	112	5	8	859
SW Arc											
Room 233	7	172	5	68	0	1	12	40	7	6	318
Unexcavated[a]	18	236	13	121	1	0	24	58	3	9	483
Total	25	408	18	189	1	1	36	98	10	15	801
ROOM TOTALS	2,059	6,863	710	3,148	58	60	885	1,616	240	278	15,917
Trash Mound[b]											
Booth 1	172	62	80	134	0	5	2	56	0	2	513
Booth 2	82	380	20	220	1	2	12	105	5	9	836
Booth 3	132	1,033	10	638	9	9	26	222	32	27	2,138
Booth 4	114	1,279	12	625	25	4	38	212	16	23	2,348
Booth 5	68	771	16	496	7	0	53	161	91	12	1,675
Booth 6	165	1,310	35	626	8	4	46	288	42	23	2,547
Trenches	1,865	12,926	875	8,584	109	85	542	2,378	321	286	27,921
Totals	2,598	17,761	1,048	11,323	159	109	719	3,422	507	382	38,028
Pit Structures											
Plaza Grid 8[c]	738	197	133	403	3	14	45	232	70	37	1,872
Kiva 1	2	4	2	4	0	0	1	1	0	0	14
Kiva 2	14	192	13	49	1	0	24	40	0	5	338
Kiva 3[c]	0	3	0	5	0	0	1	4	0	1	14
Kiva 4	0	10	0	3	0	0	0	0	0	0	13
Kiva 5	1	10	0	6	0	0	0	2	1	0	20
Kiva 6	0	8	0	6	0	0	2	3	0	1	20
Kiva 7	2	33	2	15	0	0	4	6	5	0	67
Kiva 8	2	169	7	67	0	1	23	33	1	5	308
Kiva 9	13	174	2	78	0	1	23	44	1	7	343
Kiva 10[c]	115	4,001	18	1,269	66	6	1,324	1,009	207	237	8,252
Kiva 11	2	15	2	11	0	0	1	1	0	1	33
Kiva 12	19	35	3	36	0	1	7	18	1	2	122
Kiva 13[c]	22	333	25	222	2	4	31	80	36	4	759
Kiva 14	16	175	8	123	0	1	21	64	3	2	413
Kiva 15[c]	37	201	28	149	1	2	41	68	6	6	539
Kiva 16[c]	58	1,616	27	486	2	4	214	344	43	20	2,814
Kiva 17	3	109	1	36	0	0	9	18	5	0	181
Pl. Feature 4	8	164	4	149	0	0	23	56	8	4	416
Totals	1,052	7,449	275	3,117	75	34	1,794	2,023	387	332	16,538

[a]Unexcavated; Rooms include: West Wing--100-114, 116-118, 225 (no sherds from 124, 125, 217, 224, 226); North Block--121-123, 126-160, 223; Northeast Unit--161-174, 178; East Wing--175-177, 179-192; Southeast Arc--193-205; Southwest Arc--206-216, 218-222, 231, 232.
[b]Trash Mound Trenches figure includes 714 from Slump 1, 4,803 from Slump 2, 813 from Slump 3, 16.6 % of the Trash Mound.
[c]Some portion tested; other material from wall clearing.

Table 1.2. (concluded)

Provenience	Early Grayware	Late Grayware	Early Mineral/w	Late Mineral/w	Exotic Mineral	Early Carbon/w	Late Carbon/w	White-ware	Polished Smudged	Redware	Total
	WARE GROUPS										
Plaza 1											
Grids[a]	1,722	2,915	761	1,830	7	67	441	1,182	103	105	9,133
Plaza Pits	0	6	0	3	0	0	1	0	0	1	11
Total	1,722	2,921	761	1,833	7	67	442	1,182	103	106	9,144
Plaza Feature											
Room 1	0	15	0	2	0	0	0	2	0	0	19
Room 2	0	5	1	5	0	0	0	2	0	0	9
Room 3	103	852	60	322	0	1	119	163	9	14	1,643
Room 4	105	1,187	21	160	0	2	53	113	2	11	1,654
Room 5	0	35	0	19	0	0	3	2	0	1	60
General	0	6	0	0	0	0	0	1	0	0	7
Total	208	2,100	82	504	0	3	175	283	11	26	3,392
Other Structures											
OS 1	0	0	0	2	0	0	0	1	0	0	3
OS 2	0	8	0	1	0	0	2	6	1	0	18
OS 3	14	60	8	83	0	1	18	29	3	4	220
OS 4	6	226	12	153	1	0	39	77	2	3	519
OS 5	2	36	1	43	0	0	13	35	0	4	134
OS 6	65	625	48	319	8	4	119	183	5	18	1,394
OS 7	94	443	59	234	2	3	79	139	8	19	1,080
OS 8	0	20	1	8	0	0	8	16	0	1	54
OS 9	1	37	3	28	0	0	16	16	7	4	112
OS 10	0	48	1	3	0	0	10	13	0	0	75
OS 11	0	45	2	34	0	0	8	14	1	1	105
OS 12	2	49	0	21	2	0	4	17	1	0	96
Circular Str 1	5	88	1	45	0	0	15	14	0	2	170
Circular Str 2	1	70	1	43	4	0	8	14	8	0	149
Total	190	1,755	137	1,017	17	8	339	574	36	56	4,129
Parking Lot[a]	17	30	3	29	0	1	2	22	1	1	106
East Ruin[a]	13	206	8	145	2	1	18	70	8	7	478
Plaza 2[a]	25	392	8	252	2	2	68	143	16	27	935
N trench at 138	73	8	16	45	1	0	4	16	5	2	170
Major Walls											
MW 1	34	96	29	107	1	4	12	51	2	5	341
MW 2	0	50	2	42	0	0	7	15	0	2	118
MW 3	13	277	11	238	1	0	22	64	1	1	628
MW 4	7	10	1	13	0	0	0	0	0	0	31
MW 5	1	39	4	44	0	0	7	14	1	1	111
MW 6	0	12	1	8	0	0	20	12	1	3	57
Totals	55	484	48	452	2	4	68	156	5	12	1,286
GRAND TOTALS	8,012	39,969	3,096	21,865	323	289	4,514	9,507	1,319	1,229	90,123
PERCENTAGES	8.9	44.3	3.4	24.3	0.4	0.3	5.0	10.5	1.5	1.4	

[a]Some portion tested; other materials from wall clearing.

Table 1.3. Contributions of Pueblo Alto proveniences to the detailed ceramic analysis sample.

	WARE GROUPS										
Provenience	Early Grayware	Late Grayware	Early Mineral/w	Late Mineral/w	Exotic Mineral	Early Carbon/w	Late Carbon/w	White-ware	Polished Smudged	Redware	Total
West Wing											
Room 103	5	53	13	79	9	3	23	4	5	6	200
Room 109	1	11	4	14	2	0	3	2	0	1	38
Room 110	7	55	26	102	4	4	9	2	12	7	228
Room 221	0	0	0	0	0	0	1	0	0	0	1
Room 229	0	0	0	1	0	0	0	0	0	0	1
Totals	13	119	33	196	15	7	36	8	17	14	468
North Block											
Room 145	0	1	1	0	0	0	0	0	0	0	2
Room 146	0	0	0	0	0	0	2	0	0	0	2
Room 147	0	0	0	0	1	0	0	0	0	0	1
Southwest Arc											
Room 233	0	0	0	1	0	0	0	0	0	0	1
ROOM TOTALS	13	120	44	197	16	7	38	8	17	14	474
Kiva 10	0	136	2	107	28	2	200	9	21	49	554
Kiva 13	0	24	5	25	2	0	6	3	5	1	71
Kiva 15	0	0	0	0	0	0	1	0	0	0	1
Kiva 16	0	73	4	71	7	0	45	17	11	7	235
Totals	0	233	11	293	37	2	252	29	37	57	861
Plaza 1											
Grid 8	14	17	53	26	0	5	3	3	9	3	133
Other grids	0	0	0	1	0	0	1	0	0	0	2
Totals	14	17	53	27	0	5	4	3	9	3	135
Other Struct. 7	0	0	0	0	0	0	0	0	0	1	1
Trash Mound[a]											
TT 1 surface	0	37	6	40	0	0	5	4	0	3	95
TT 1 Gr. 1	0	6	2	11	1	0	1	2	2	0	25
TT Gr. 71	0	0	0	5	0	0	0	0	0	0	5
TT Gr. 99	0	1	4	7	1	0	0	0	0	0	13
TT Gr. 127	1	7	1	20	0	0	1	3	1	0	34
TT Gr. 155	5	68	17	118	3	1	2	5	3	3	225
TT Gr. 183	12	113	15	157	5	1	6	6	8	9	332
TT Gr. 191	0	1	0	0	0	0	0	0	0	0	1
TT Gr. 211	16	125	32	153	1	3	9	10	8	9	366
TT Gr. 239	8	98	14	122	10	2	19	5	5	5	288
TT Gr. 267	4	92	10	124	2	2	20	4	4	3	266
TT Gr. 295	8	80	8	95	5	0	13	8	3	2	222
TT Gr. 323	3	72	5	68	5	0	9	9	10	2	183
TT BH cut 1	8	18	28	28	0	0	1	2	1	0	86
TT BH cut 2	0	4	6	11	0	0	0	3	0	0	24
TT BH cut 3	8	13	26	16	2	3	1	6	0	0	75
Slump 1	0	0	0	2	0	0	0	0	0	0	2
Totals	73	735	174	977	36	10	87	69	45	36	2,242
Booth 1	24	12	34	21	3	1	0	0	0	1	96
Booth 2	13	22	2	38	1	0	2	0	2	2	82
Booth 3	14	120	2	162	6	5	6	5	3	7	330
Booth 4	14	166	3	185	12	0	14	1	2	5	402
Booth 5	11	142	4	180	12	0	25	2	10	4	390
Booth 6	4	170	10	140	15	0	12	2	5	3	361
Totals	80	632	55	727	49	6	58	10	22	22	1,661
TRASH TOTALS	153	1,367	229	1,704	85	16	145	79	67	58	3,903
GRAND TOTALS	180	1,737	337	2,131	138	30	439	119	130	133	5,374
PERCENTAGES	3.3	35.0	6.3	39.7	2.6	0.6	8.2	2.2	2.4	2.5	

[a]TT = Test Trench, Gr. = Grid, BH = backhoe.

Late Carbon-on-white--Chuska, Chaco McElmo, Mesa Verde Black-on-white, general Chuska and Tusayan decorated whiteware, and PII-III carbon

Whiteware--undecorated whiteware

Polished Smudged--all polished smudged

Redware--plain and decorated redware and polychrome of all series.

Even at the rather gross level of provenience lumping used for the tables some of the distinctive features are apparent, such as the early sherds from the pitstructure in Plaza Grid 8, the "late mineral" (Gallup Black-on-white) dominance of the Trash Mound, and the late carbons in Kiva 10. Such discussion belongs in the time-space and function sections, but it does serve to illustrate why the proveniences used for detailed analysis were chosen.

The question is, however, what does the detailed ceramic sample from Pueblo Alto represent? That is, the provenience summary tables show clearly that over 20 percent of the bulk sherds come from proveniences not sampled at all for the detailed analysis, and that several excavated proveniences are barely represented in the detailed analysis. The most noteworthy examples of the latter are the North Roomblock suite and the Plaza Feature rooms. The rooms in the North Block are distinguished above all for their nearly complete lack of artifactual material in any context, but especially on floors. It might be argued that 6,600 sherds from this very large fill volume is not very different from the amount that might be expected from wall clearing. The materials from these proveniences are, of course, less subject to "redistribution" than those on the surface, but attributing significance to them beyond site provenience is almost as risky. This argument is less applicable to the Plaza Feature rooms--the sherd counts are greater and the fill volume much less. Probably omission of materials from the Plaza Feature is an oversight, though the deposits there lack the unitary nature of those sampled. Although it would not have produced enough items in secure enough context to make reliable functional interpretations, it would have been better to have included floor context items from the early Rooms 50, 51, and 236, the superimposed Rooms 143, 139, 145-147, and the Plaza Feature rooms.

Table MF-1.3 shows occurrence by gross proveniences in the detailed and bulk samples. Keeping in mind that the samples are <u>not</u> equivalent (the grayware-whiteware imbalance is again evident in the within-provenience percentage rows), one may compare contributions. Clearly, the detailed analysis sample heavily emphasizes ceramics from the Trash Mound; proveniences that constitute a larger proportion of the rough sort than the detailed analysis are rooms and all other proveniences, with kivas contributing equally to both samples. All decorated wares and polished smudged wares are relatively more frequent in the detailed sample than in the bulk sample, but only early carbon-painted items are so in all proveniences. In the trash proveniences only exotic mineral-on-white in the trench and whiteware in the booths constitute smaller proportions of the detailed analysis than of the bulk sample. The Trash Mound is emphasized

in the detailed sample both because it is a focal point of interest to the project, and because it produced by far the most ceramics of any of the excavated deposits.

It is not possible to determine with these figures whether the detailed sample is a true representation of the vessels from the proveniences selected. What has been shown is from where the sample was drawn and how it differs in broad terms from the overall collection of ceramics. What it represents, then, is an approximation of vessel counts from nine major, depositionally coherent proveniences, plus some miscellany. The detailed analysis sample is a form of maximization strategy--rather than analyzing a sample from the entire collection and then pulling the proveniences thought to merit further analysis, the entire effort was invested in those proveniences. Some potentially interesting proveniences and sherds probably have been passed over, but the sample is an expedient and, under the conditions, optimal one.

Detailed Analysis Sample

Once the proveniences were chosen, the selection process for the detailed-analysis ceramic sample was fundamentally the same as for the other sites. There remains, then, the need for an archeological/ceramic explanation for the differences in the grayware-whiteware detailed-bulk ratios between Pueblo Alto and 29SJ 627 and 29SJ 629. We speculate that the deposits from which our Alto collection comes were subject to much less disturbance than those at either of the smaller sites. The Trash Mound at Alto is clearly undisturbed and most likely represents discrete, intermittent deposition of accumulated refuse within a relatively short period (A.D. 1000-1075 or 1100); the layers are not compacted, and the traffic in this area was probably slight [even if Lekson (1984) does think it was a temple platform mound]. Much the same can be said for Kiva 10's deposits. These two deposits account for over 80 percent of the Alto collection. Moreover, a high percentage of the culinary sherds from Alto are trachyte-tempered, and McKenna (1980:5) has found evidence that such sherds survive in larger pieces than other sherds. Although the smaller sites have proveniences that are single-episode deposits, the likelihood of redeposition is greater than at Alto. In addition to more prehistoric human redeposition, there are other factors that probably served to reduce sherd size or, in other words, to increase the number of sherds per vessel. The small sites are subject to alluviation whereas all filling at Alto is aeolian; compaction is thus likely to have been greater at the smaller sites; the deposits at the small sites are also generally older than those at Alto. Because graywares are usually larger, greater bulk sherd count versus vessel count is expected; the less comminution of the sherds, the closer the sherd count to the vessel count, and it is this that we proffer in this case.

Site 29SJ 1360 deviates from these proportional grayware-whiteware shifts in bulk and controlled samples, showing more whiteware than grayware in the bulk counts (McKenna and Toll in McKenna 1984:123). The ceramics of 29SJ 1360 are, however, indeed an exception in that abandonment

of the site seems to have been such that many nearly intact vessels remained. McKenna (1984:495) has identified more than a hundred restorable vessels and is quite certain that others are present. This is an inordinate number when compared even to Pueblo Alto where there are 38, if we use a lenient definition of restorable, and the apparent "exception" can thus be used to substantiate rather than obviate the explanation.

McKenna's findings as to sherd size variation by temper at Pueblo Alto (1980:5) and the whole vessels at 29SJ 1360 both serve to emphasize the futility of relying on bulk sherd counts for more than inventory. For example, if trachyte-tempered and sandstone-tempered graywares are on the average similar in size when whole, but break such that trachyte sherds are around twice as large as sandstone sherds (as suggested by McKenna), sandstone will be twice as abundant in the bulk count. Similarly, any bulk comparison of 29SJ 1360 with another site will suggest that grayware at 29SJ 1360 is relatively infrequent.

In addition to drawing sherds from selected proveniences, a time economy was employed in the analysis of the sherds from Test Trench 1 of the Trash Mound, the main cross-cutting trench. This trench yielded a very large number of sherds (n = 27,000; see Table 1.2) in arbitrary levels. As previously discussed, a matched rim-based sample was drawn from this group; the surface attributes of these sherds were recorded, but the rim sample was further sampled for temper analysis as follows.

Using the rectilinear grid formed by the arbitrary 20-cm levels (horizontal lines) and the Trash Mound Grid system (vertical lines), a systematic sampling scheme was devised (Figure 1.4). It was designed to cover the trench both horizontally and vertically. The sample is such that every third unit is included, both vertically and horizontally. The starting point for selecting units is Level 1 in Grid 183. The surface has been excluded, and materials from all three backhoe cuts were included in their entirety. Also excluded are all of the units in Grid 211 because it contains an unknown quantity of backdirt from Roberts' test; it has been treated as if it did not exist. The one exception to strictly systematic use of the grid is in Grid 183 where Level 3 was arbitrarily included to fill a gap in the every-third-square pattern.

Excluding Grid 211, there are 111 grid-level units in the trench; the scheme selected 37 of these, or exactly one third. With the inclusion of the three backhoe cuts, which volumetrically equal 47 grid-level units, coverage of the controlled Trash Mound Test Trench 1 comes to 53.2 percent for the temper analysis. This areal coverage converts to 31.1 percent of the total trench detailed sample or 38 percent of the sample, excluding the Grid 211 column. The low ceramic content of the backhoe cuts contributes to the fact that the ceramic percentage is less than the areal coverage. The booths in the Trash Mound were dug in natural layers, and the ceramics from these proveniences were fully analyzed. In the 29SJ 629 and 29SJ 627 analyses the temper analysis samples are almost identical with the rim samples from those sites, while at Pueblo Alto the rim sample is larger because of this reduction of temper sample size from the Trash Mound.

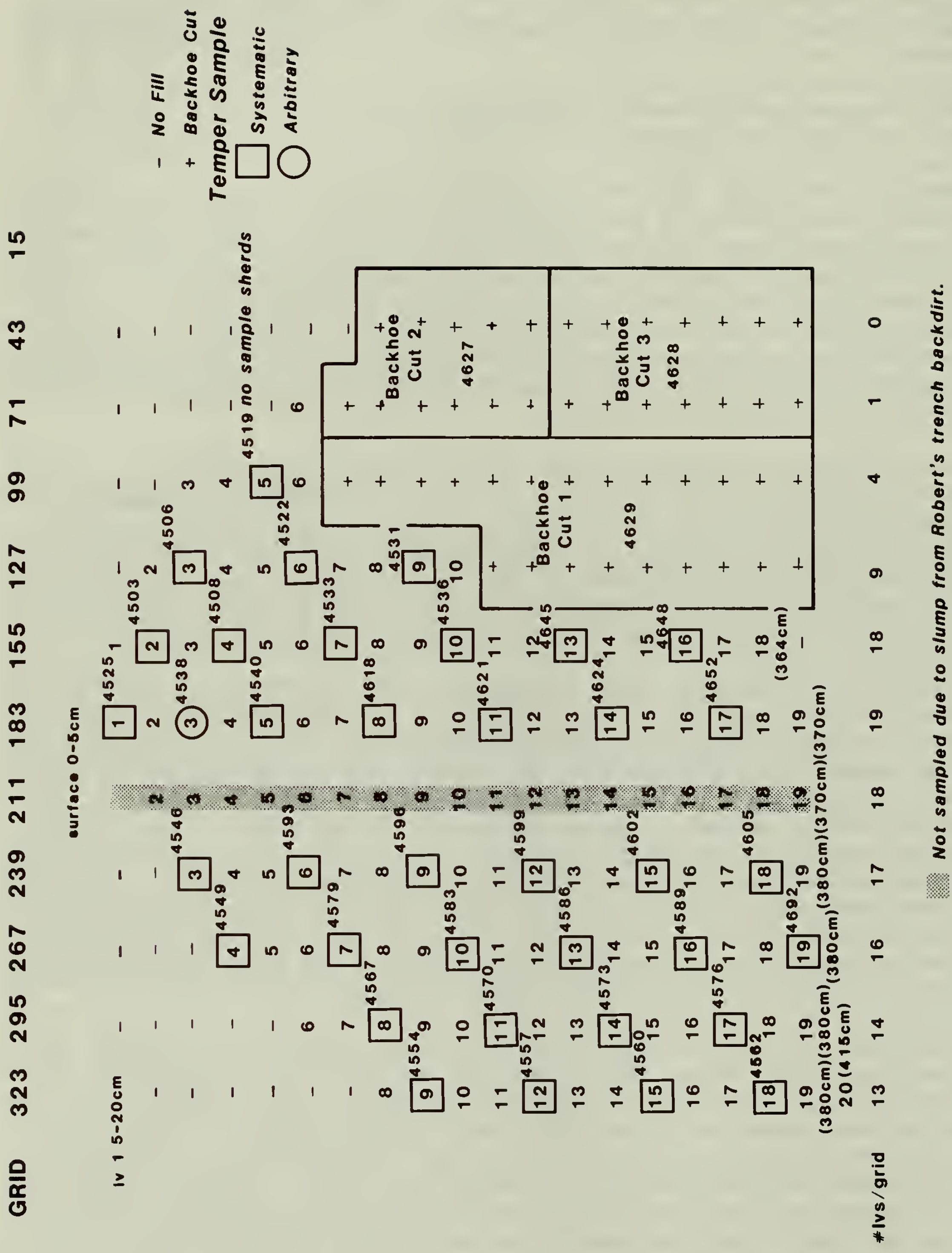


Figure 1.4. Temper analysis sampling scheme from Trash Mound Test Trench 1.

Summary of the Ceramic Characteristics of the Sample

As compared to 29SJ 627 and 29SJ 629 the distribution among wares of the Pueblo Alto ceramics is considerably more even (Table 1.4). Pueblo Alto's collection of rim sherds contains higher percentages of grayware, carbon-on-white, and polished smudged than either of the two smaller sites. The category with a markedly smaller percentage at Alto is that of mineral-on-white. Some of these differences are explicable in terms of relative site dates--in particular, the twofold increase in the relative frequency of carbon-on-white ceramics is temporal. The incidence of grayware--35 percent of the rims at Pueblo Alto as compared to 19 percent at 29SJ 629, 24 percent at 29SJ 1360, and 22 percent at 29SJ 627--cannot be attributed to temporal differences and is significantly different (Toll 1984a). This significant difference seems likely to be very important in the relationship of large to small sites and will be closely monitored in this report. Indeed, this differential proportion of wares affects site comparisons of major distributions in several attributes. The incidence of polished smudged ware is also interesting as it is not necessarily temporal.

The high precentage of grayware at Pueblo Alto has an effect on vessel form occurrences (Table 1.5)--the heavy predominance of bowls found at 29SJ 627 and 29SJ 629 (61-66 percent) is diluted at Pueblo Alto to 49 percent of the total vessel assemblage. Most other forms are remarkably similar in percentage among the three sites. Tecomates are somewhat less frequent at Alto, and ollas somewhat more, but neither is greatly different. Given the high frequencies of Gallup and Chaco McElmo at Alto, it is surprising that the percentage of pitchers at Pueblo Alto is nearly the same as that at 29SJ 627, as this form most often occurs in these types, and these types are proportionately better represented at Pueblo Alto.

In temper as well, the graywares set Pueblo Alto apart from the other sites in that the overall percentage of trachyte at Alto is twice that at 29SJ 627 and thrice that at 29SJ 629 (Table 1.6). The trachyte occurrence in carbon-painted wares is around 60 percent at all three sites and the level of mineral-painted wares is similar at 29SJ 627 (8.6 percent) and 29SJ 629 (10.2 percent) and more than double at Pueblo Alto (24 percent). The greatest absolute frequencies of trachyte are found in the graywares at all three sites, and, again, Pueblo Alto has more than twice the occurrence of the two smaller, largely earlier sites (52 percent vs. 23-24 percent). Chalcedonic sandstone, on the other hand, is least frequent at Pueblo Alto, though this temper follows a similar pattern there, as it is found only in grayware and whiteware with the grayware showing somewhat more than twice the percentage of the whiteware.

San Juan igneous temper occurs in 1-3 percent quantities in gray and whitewares similar to those found at 29SJ 627; percentages at 29SJ 629 are somewhat higher (to 4.4 percent). Pueblo Alto differs substantially from the two other sites in having much less San Juan igneous temper in redwares (35 percent as opposed to 60-65 percent). As noted at 29SJ 627, San Juan redware is present in proveniences thought to postdate the A.D. 1000

Table 1.4. Contents of various ceramic samples, Pueblo Alto.

Rough Sort Type	Rough Sort Count	Rough Sort Percent	Detailed Count	Detailed Percent	Temper Count	Temper Percent	Rim Count[a]	Rim Percent
Plain Gray	4,488	5.0	29	0.5	28	0.7	1	0.02
Lino Gray	2	0.00	0		0		0	
Lino Fugitive	2	0.00	0		0		0	
Polished Tan	1	0.00	0		0		0	
Wide Neckbanded	247	0.3	17	0.3	17	0.4	11	0.3
Narrow Neckbanded	3,021	3.4	110	2.0	73	1.9	83	2.1
Neck Corrugated	254	0.3	24	0.4	19	0.5	15	0.4
PII Corrugated	627	0.7	392	7.3	228	5.9	388	9.6
PII-III Corrugated	279	0.3	115	2.1	98	2.5	115	2.9
PIII Corrugated	102	0.1	46	0.9	38	1.0	46	1.1
Unid. Corrugated	38,961	43.2	1,184	22.0	847	22.0	749	18.6
TOTAL GRAY	47,984	53.2	1,917	35.6	1,348	35.0	1,408	34.9
BMIII-PI Pol. M/w	5	0.01	0		0		0	
BMIII-PI Unpol. M/w	12	0.01	2	0.04	1	0.03	2	0.05
Early Red Mesa	177	0.2	21	0.4	16	0.4	17	0.4
Red Mesa B/w	2,902	3.2	314	5.8	227	5.9	257	6.4
Escavada B/w	646	0.7	142	2.6	88	2.3	118	2.9
Puerco B/w	1,736	1.9	285	5.3	213	5.5	185	4.6
Gallup B/w	8,595	9.5	1043	19.4	736	19.1	645	16.0
Chaco B/w	258	0.3	42	0.8	42	1.1	15	0.4
Exotic M/w	323	0.4	137	2.5	113	2.9	93	2.3
PII-III M/w	10,630	11.8	618	11.5	381	9.9	571	14.2
TOTAL M/w	25,284	28.0	2,604	48.4	1,817	47.2	1,903	47.2
BMIII-PI Pol. C/w	37	0.04	1	0.02	1	0.03	1	0.02
BMIII-PI Unpol. C/w	3	0.00	0		0		0	
PII-III C/w	1,646	1.8	98	1.8	94	2.4	86	2.1
Mesa Verde B/w	7	0.01	4	0.1	4	0.1	3	0.1
Chaco McElmo B/w	804	0.9	77	1.4	76	2.0	68	1.7
Chuska B/w	560	0.6	81	1.5	58	1.5	53	1.3
Chuska Whiteware	1,087	1.2	138	2.6	116	3.0	121	3.0
Red Mesa desn Chuska	249	0.3	29	0.5	22	0.6	17	0.4
Tusayan Whiteware	410	0.5	44	0.8	29	0.8	38	0.9
TOTAL C/w	4,803	5.3	472	8.8	400	10.4	387	9.6
Unid. Whiteware	9,507	10.5	117	2.2	78	2.0	107	2.7
TOTAL WHITEWARE	39,594	43.9	3,194	59.3	2,295	59.6	2,397	59.4
Plain Red	42	0.05	4	0.1	4	0.1	2	0.05
Decorated Red	1,171	1.3	125	2.3	95	2.5	99	2.5
Polychrome	16	0.02	4	0.1	4	0.1	1	0.02
TOTAL REDWARE	1,229	1.4	133	2.5	103	2.7	102	2.5
Polished Smudged	1,319	1.5	130	2.4	100	2.6	122	3.0
Brownware	9	0.01	3	0.1	3	0.1	1	0.02
Mudware	4	0.00	4	0.1	4	0.1	4	0.1
GRAND TOTALS	90,139		5,380		3,853		4,034	
% of Rough Sort			6.0		4.3		4.5	
% of Detailed Analysis					71.6		75.0	

[a]Total number of rim sherds in the temper analysis = 2,547 (66.1% of the temper sample).

Table 1.5. Vessel forms of all rough sort types, Pueblo Alto.[a]

Rough Sort Type	Bowl	Ladle	Canteen	Pitcher	Seed Jar	Tecomate	Jar	Olla	Duck Pot/ Miniature[b]	Total
Plain gray				1			28			29
Wide neckbanded							17			17
Narrow neckbanded							110			110
Neck corrugated							24			24
PII corrugated				1			389			390
PII-III corrugated							115			115
PIII corrugated				1			45			46
Unident. corrugated				1			1,183			1,184
GRAYWARE TOTALS				4			1,911			1,915
% of ware				0.2			99.8			
Unpolished BMIII-PI	2									2
Early Red Mesa B/w	16	1		1			3			21
Red Mesa B/w	244	36		5	1		25	1	1	313
Escavada B/w	106	12		8	4	1	10	1		142
Puerco B/w	178	33	3	9		2	49	10		284
Gallup B/w	592	49	2	83	13	9	266	23	4	1,041
Chaco B/w	12		1	11		1	16	1		42
Exotic M/w	102	13	1	3	1		16	1		137
PII-III M/w	353	59	12	24	7	5	62	83	8	613
MINERAL-ON-WHITE	1,605	203	19	144	26	18	447	120	13	2,595
% of ware	61.8	7.8	0.7	5.5	1.0	0.7	17.2	4.6	0.5	
Unidentified white	59	13	1	5	1	2	17	17	1	118
BMIII-PI Pol. C/w	1									1
Chuska, Red Mesa desn	16	8		1			4			29
Chuska B/w	58	6		2		1	12	2		81
Chuska C/w	89	25		2		1	13	8		138
Tusayan C/w	42	2								44
Chaco McElmo B/w	53	3	1	14			4	2		77
PII-III C/w	71	8	1	3			9	5	1	98
Mesa Verde B/w	3							1		4
CARBON-ON-WHITE	333	52	2	22		2	42	18	1	472
% of ware	70.7	11.0	0.4	4.7		0.4	8.9	3.8	0.2	
WHITEWARE TOTALS	1,998	268	21	171	27	22	507	155	15	3,184
% of ware	62.8	8.4	0.7	5.4	0.8	0.7	15.9	4.9	0.5	
REDWARE	120		1	2	4	1	5			133
% of ware	90.2		0.8	1.5	3.0	0.8	3.8			
Polished smudged	127	2								129
Brownware	1						2			3
Mudware	4									4
Rims-only white	1,760	183	20	136	25	21	107	132	15	2,399
redware	93		1		3	1	2			100
smudged	119									119
grayware				3			1,406			1,409
Total rims	1,972	183	21	139	28	22	1,515	132	15	4,027
% Rims	87.7	67.8	95.5	78.5	90.3	95.7	62.5	85.2	100	75.0
GRAND TOTALS	2,249	270	22	177	31	23	2,425	155	15	5,367
PERCENTAGES	41.9	5.0	0.4	3.3	0.6	0.4	45.2	2.9	0.3	

[a]Not shown are 1 cylinder jar (Gallup), a rim; 1 gourd jar (PII-III M/w), a rim; 1 mug (PII-III M/w), a rim; 11 with unknown form, 4 rims.

[b]Duck Pot/Miniature includes 2 duck pots (both rims) and 13 miniatures (all with rims).

Table 1.6. Pueblo Alto temper types tabulated by rough sort types (tempers have been lumped and only items with observable temper have been included).[a]

Rough Sort Type	Sand-stone	Sherd> Sandstone	Chalcedonic Sandstone	Fe-bearing Sandstone	San Juan	Trachyte	Sandstone-Trachyte	Unidentified Igneous	Total
Plain gray	17	1		2		7	1		28
Wide neckbanded	10	1	3	1		2			17
Narrow neckbanded	38	1	4	1		27	2		73
Neck corrugated	9	1	1	1		7			19
PII corrugated	79	7	15	1	4	124			230
PII-III corrugated	34	2	1		1	59	1		98
PIII corrugated	17	1	1	1	2	15	1		38
Unident. corrugated	282	24	56	13	8	461	—	3	847
GRAYWARE TOTALS	486	38	81	20	15	702	5	3	1,350
GRAYWARE %	36.0	2.8	6.0	1.5	1.1	52.0	0.4	0.2	
Unpolished BMIII-PI	1								1
Early Red Mesa B/w	2	13							15[b]
Red Mesa B/w	61	121	15		1	9	15	1	223
Escavada B/w	16	61	5		1	1	3	1	88
Puerco B/w	36	134	4		4	6	20	6	210[c]
Gallup B/w	122	325	12	1	3	136	126	9	735
Chaco B/w	8	18				4	11	1	42
Exotic M/w	18	26	1		21	21	6	16	109[d]
PII-III M/w	84	193	11	1	8	33	39	11	380
MINERAL-ON-WHITE	348	891	48	2	38	210	220	45	1,802
M/W %	19.3	49.4	2.7	0.1	2.1	11.7	12.2	2.5	
Unidentified white	13	34	5			18	6	1	77
BMIII-PI Pol. C/w	1								1
BMIII-PI Unpol. C/w									
Chuska, Red Mesa design						22			22
Chuska B/w						56	1		57
Chuska C/w	5	1				99	11	1	117
Tusayan C/w	26						1	2	29
Chaco McElmo B/w	15	14			1	21	19	4	74
PII-III C/w	14	32			7	21	11	9	94
Mesa Verde B/w	—	—			—	4	—	—	4
CARBON-ON-WHITE	61	47			8	223	43	16	398
C/w %	15.3	11.8			2.0	56.0	10.8	4.0	
WHITEWARE TOTALS	422	972	53	2	46	451	269	62	2,277
WHITEWARE %	18.5	42.7	2.3	0.1	2.0	19.8	11.8	2.7	
Decorated redware	10	48			36			1	95
Plain red		2						2	4
Polychrome	2	2							4
REDWARE TOTALS	12	52			36			3	103
REDWARE %	11.7	50.5			35.0			2.9	
Polished smudged	25	60						15	100
Brownware	2	1							3
Mudware	4								4
GRAND TOTALS	951[e]	1,123	134	22	97	1,153	274	83	3,843[f]
PERCENTAGES	24.7	29.2	3.5	0.6	2.5	30.0	7.1	2.2	

[a]Temper not observable: 12.
[b]Early Red Mesa--plus 1 Socorro temper.
[c]Puerco--plus 1 shale temper.
[d]Exotic M/w--plus 4 Socorro temper.
[e]Includes "Tusayan Sandstone," a typologically generated temper code.
[f]Includes the following: 0.1% Socorro (5) and 0.03% shale (1). These 6 sherds not included elsewhere.

termination of the series now in use (Lucius and Breternitz 1981; but see Breternitz et al. 1974:Table 1), showing the series extending as late as A.D. 1100 in some reckonings, including A.D. 1075 in Breternitz 1966). The reduction in occurrence of San Juan temper is a temporal phenomenon, no matter what the terminal production date of San Juan Redware. The increase in sherd and sand-tempered redware at Pueblo Alto shows the establishment of the White Mountain redware and, to a lesser degree, Tsegi orangewares in the San Juan Basin.

Type Descriptions

Procedural and Definitional Considerations

Each of the sites processed by the final analysis is characterized by abundance of a few types, depending on the site's period of occupation. It has been our practice to give detailed treatment for the specific types (as opposed to lumped, catch-all types) that comprise 2.5 percent or more of the entire detailed-analysis sample (see Table 1.4). At Pueblo Alto the types meeting that criterion are Red Mesa, Puerco, Escavada, Gallup Black-on-white, and Pueblo II corrugated. The rules have been bent here somewhat to include PII-III corrugated (2.1 percent of total, but 2.5 percent of the rim sample), Chaco McElmo (1.4 percent of total, 2.0 percent of temper), and PII-III Carbon-on-white (1.8 percent of total, 2.4 percent of temper). These exceptions were made for two reasons. First, these types would not have been treated in detail for any site. Second, the shift to carbon paint in later Chaco contexts is of some interest, and the composition of this ambiguous group is important to understanding this juncture of ceramic change.

Because types are a chronic source of contention and confusion, an outline of the criteria used to distinguish each follows. These definitions are composites of several sources--Windes' definitions (1984), McKenna's definitions from other reports (McKenna and Toll 1984; Toll and McKenna 1981, 1982), and Toll's interpretations of how the types have been used in practice. The sections that follow give the empirical composition of each type in some depth; the definitions are intended to communicate the criteria for sherd placement in type groups.

There are a number of earlier definitions of Cibola ceramics from the Chaco region, and all have some influence on definitions as they have been applied here. The Gladwins (1930) initiated most of the type names now in use, and present usage bears some similarity to theirs. Hawley's (1934, 1936) system relied heavily on surface finish and some carryover from her system is present, as well, particularly for Escavada Black-on-white. Of all foregoing type divisions, that made by Roberts (1927) corresponds best with ours, though all type names are different. Gordon Vivian's (1959, 1965) definitions of types are also not far removed from those used by McKenna and Windes, presumably because of type refinement and Vivian's familiarity with Roberts' work. It is in the later carbon wares that our definitions are probably the most different from earlier ones. The recog-

nition of the Chuska series (Windes 1977) and the naming and specification of Chaco McElmo permit more precise handling of later carbon-on-white from Chaco. Even with these improvements, this group remains the one most in need of further refinements. This problem is addressed to some extent in this report and further by Franklin (1982) for the Bis sa'ani Community ceramics.

Operational Definitions

Cibola Whiteware. In 1958 a conference was held at the Museum of Northern Arizona to address the problem that

> Of all the Anasazi pottery wares, Cibola White Ware has offered the most difficulties to the Ceramic taxonomist. The difficulties were so great that the ware was omitted from the Handbook of Northern Arizona Pottery Wares (Colton and Hargrave 1937). [Cibola White Ware Conference 1958]

In 1978 a similar conference was called because the confusion continued. Much of the confusion may be attributed to a very large lump in a field that has a long tradition of finer and finer splitting, as well as a history of pragmatic provincialism. Pottery called Cibola is found in a very large area consisting roughly and principally of the northeastern fourth of Arizona and the northwestern fourth of New Mexico, with some spillage around the edges. In an area that more than encompasses the modern pueblos (among whom there is very noticeable ceramic variation), it is hardly surprising that the concept of a single ceramic group containing substantial variation is confusing. We are certainly party to both provincialism and confusion because, when we think of the the Cibola wares, we think of a set of attributes modal in Chaco. This report and those on 29SJ 629, 29SJ 627, 29SJ 1360, and others show that there is considerable variability within the types that have been placed in Cibola Whiteware, even from this very restricted area.

It would be more precise for us to refer to the Chaco Series, or the Puerco-Chaco Series, or the McKinley Series (Cibola White Ware Conference notes 1958), but it is clear from the choice of names that they, too, have been a source of confusion. Windes (1984) discusses the Chaco Cibola Whitewares and points out that the greatest divergence within Cibola as a whole occurs late in its production (i.e., PII-III); his is the most complete published description of our use of these type names. The classification given by Marshall et al. (1979:253-254) demonstrates how finely ceramics from the San Juan Basin can be split. Marshall's listing of types within the Chaco series of Cibola Whiteware is the same as ours for the mineral-paint part of the series, though we allow greater variability in temper (that is, we do not recognize Newcomb Whiteware, their name for mineral-painted, trachyte-tempered whiteware). In the carbon-paint part of the series, Marshall includes Chaco McElmo in Mesa Verde Whiteware, while we consider Chaco McElmo to be in the Chaco Cibola series.

"Cibola" is used here primarily to distinguish the largest group of whitewares from others that are likely to be nonlocal. Clearly, a strict usage of Cibola includes types from areas distant to Chaco--Reserve, Cebolleta, and Snowflake Black-on-white, among many others, are nonChacoan Cibola types. Such types, when identified, were placed in the category "exotic mineral-on-white." In this report the "Cibola types" discussed are Early Red Mesa/Kiatuthlanna (very rare at Pueblo Alto), Red Mesa, Puerco, Escavada, Gallup, and Chaco McElmo Black-on-white. The modal characteristics of all are grayish core with carbon streaking relatively less common, white slip often sparingly applied, sand and sherd temper in some combination, thin hard walls, black-on-white designs (produced with a reducing firing atmosphere). All but Chaco McElmo have mineral paint; all but Escavada show some polish; all vary considerably around the mode. The illustrations referred to below are all drawn from the site's whole vessels and are, thus, uneven in representation. Windes (1984) and the sherd groups pictured by Windes in Volume I of this report can be used as supplements to these.

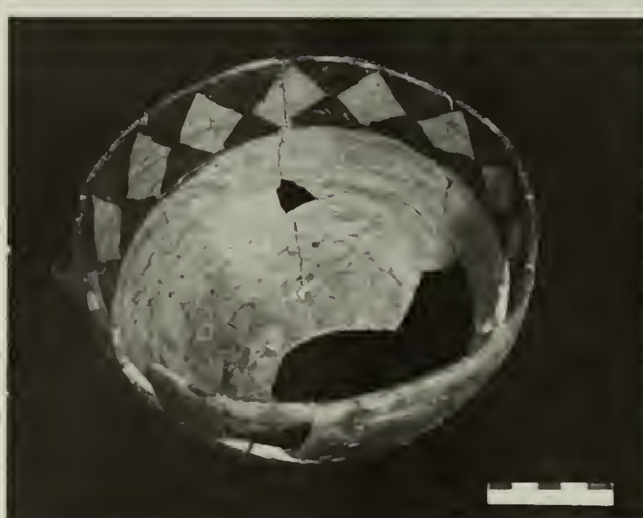
Red Mesa Black-on-white (Plates 1.1, 1.2). This type is probably the most abundant, decorated whiteware in Chaco but not at Pueblo Alto. It is generally a fairly thin, well-fired pottery with good polish. It is virtually always slipped, though the slip may be thin and streaky. Bowl rims are usually painted solid with a line break. The norm for paint is a dense matte-black mineral, though there is color variability. The most important criterion for distinguishing Red Mesa from other Cibola mineral-painted types is design. Common designs include interlocking scrolls, ticked or scalloped triangles, checkerboards, and frets. Layouts are usually in bands, and elements are frequently framed by narrow parallel lines. The hachure found in Red Mesa has framing and hatch lines of equal width, with the hachure relatively widely spaced; hatch lines are either straight or wavy (squiggled) and are usually perpendicular to the framing lines. Associated dates, stratigraphic evidence, and other experience lead to an estimated production span for Red Mesa of A.D. 875-1050. The dates presented with these descriptions are, of course, approximations; they are intended to bracket the likely years of production rather than give peak usage (see Windes 1984).

Puerco Black-on-white (Plates 1.3, 1.4). Puerco tends to be somewhat less well polished than Red Mesa but is also always slipped and polished. Puerco exhibits most of the common motifs seen in Red Mesa, except that hachure is a minor and infrequent component, and that Puerco tends more toward scalloping than ticking. One of the main differences from Red Mesa is in execution of design--in Puerco lines are broader and elements larger and less carefully executed than in "typical" Red Mesa. Another difference is a tendency toward "Sosi" layouts, which are running diagonal or helical layouts with interlocking parts. Sosi design layouts are rare in items classed as Red Mesa, but band layouts are found in Puerco. By definition, elements are painted solid in Puerco. The estimated production span for Puerco is A.D. 1030-1200.

Escavada Black-on-white. Unlike the other mineral-on-white members of the Cibola whitewares, Escavada is distinguished primarily by surface

A

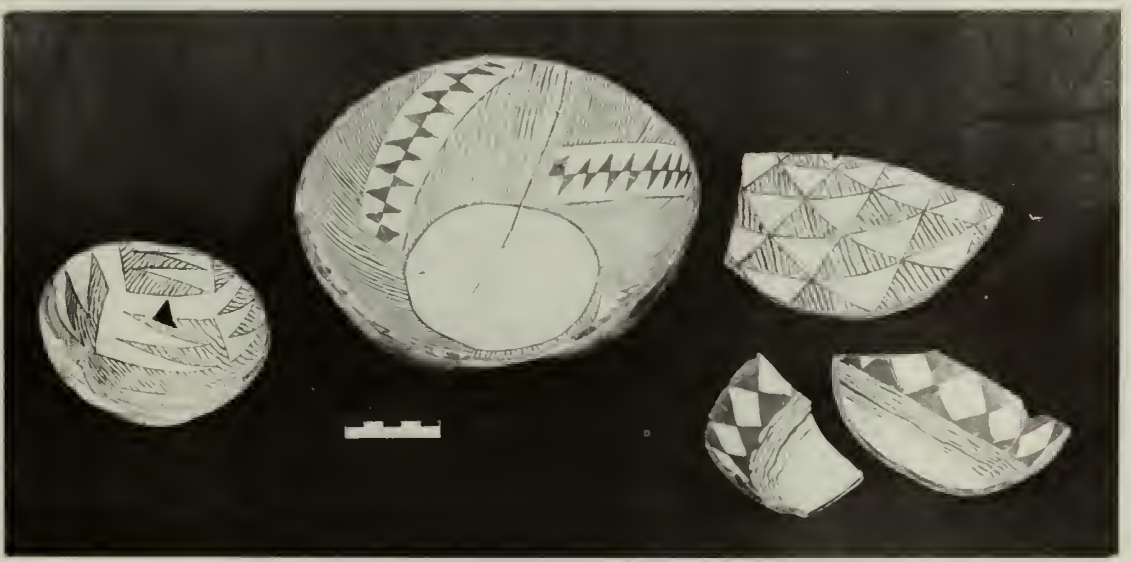
B



C

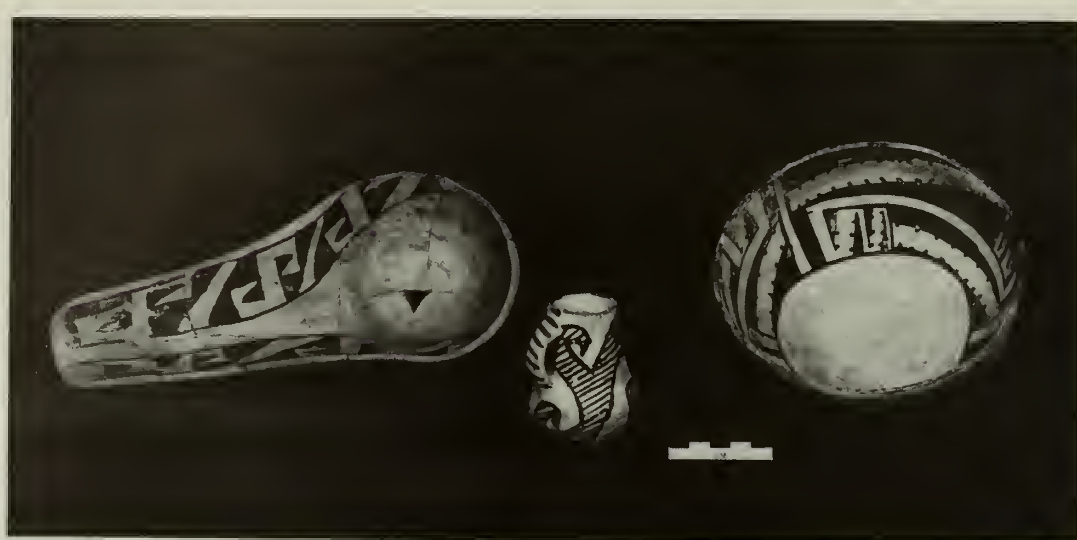
Plate 1.1. Vessels from Room 145 and 147 floors.
A. PII-PIII Mineral-on-white miniature effigy vessel.
B. Chaco Corrugated jar.
C. Mancos Black-on-white bowl.

A



B

Plate 1.2. Bowls from Trash Mound Booths 5 and 6.
A. Gallup Black-on-white.
B. L - R: Gallup Black-on-white, Late Red Mesa Black-on-white, Gallup Black-on-white, and Puerco Black-on-white.



A

B

Plate 1.3. Whole vessels from Room 110.
A. L - R: Toadlena Black-on-white ladle, Gallup Black-on-white miniature pitcher, and Puerco Black-on-white bowl.
B. Chuskan utility jars, Blue Shale Corrugated.

A

B

Plate 1.4. Puerco Black-on-white bowl from Room 229.
A. Interior.
B. Exterior.

texture rather than design. It is by definition unpolished; the surface is usually white, but the use of slip is difficult to see, and, subjectively, Escavada sometimes looks yellower than the other Cibola types. Contributing to its rough surface is the frequently coarse, quartz temper. The designs are most similar to those of Puerco; however, hachured items are included in Escavada, though they are not common. The paint is more often brownish in Escavada than in Puerco, and the rough texture often gives the paint a freckled appearance. Escavada is perhaps more restricted in production span than Puerco and Gallup--it is estimated at A.D. 1000-1100.

Gallup Black-on-white (Plates 1.1, 1.2, 1.3, 1.5, 1.6, and 1.7). Gallup is first and foremost a hachured type. Hachure lines are usually narrower than framing lines, and there is great variability in width of framers and types of hachures. The hachure is almost invariably at an angle to the framing lines. Solid elements may be counterposed to hachured ones but not to the extent seen in Reserve Black-on-white. Non-band layouts are even more common in Gallup than in Puerco, with running panels and quartered fields two common configurations. Vessel walls continue to be relatively hard and thin. Gallup design fields are polished, but the thin, chalky slip means that normative Gallup lacks the pearly feel of normative Red Mesa. Slip-slop, a band of slip extended over the vessel rim from the slipped, decorated surface to the undecorated, mostly unslipped surface (exteriors of bowls or interiors of jars), and "ownership marks," markings in slip or paint on vessel bases or bowl exteriors are more common in Gallup and Puerco than they are in Red Mesa (both are illustrated in Windes 1984). Gallup is thought to have been contemporary with Puerco, A.D. 1030-1200.

"Puesga". It will be noted that Puerco, Escavada, and Gallup Black-on-white are all basically contemporaneous, though there is some difference in the beginning and ending dates in various dating schemes. The three are separated on the basis of design (Puerco and Gallup) and on the basis of surface treatment (Escavada). This classification differs from the approach taken in the Mesa Verde Region, for example, where PII ceramics contemporaneous with these three types and having the same range of decoration and surface treatment are all included in the single type Mancos Black-on-white (Breternitz et al. 1974). This inconsistency has caused great terminological turmoil concerning these three types: they have all been included under Puerco Black-on-white (Gladwin and Gladwin 1931; Hargrave 1964:24-27), and were still differently divided by Hawley (1936). While we have retained them as three separate types (see Windes 1984), separately they are not comparable to either Red Mesa Black-on-white or to Chaco McElmo. Therefore, we have grouped the three under the acronym "Puesga", from the initial letters of each and from the Spanish word pues meaning "well, perhaps." Colton (1953) made a similar recombination in "McKinley Black-on-white."

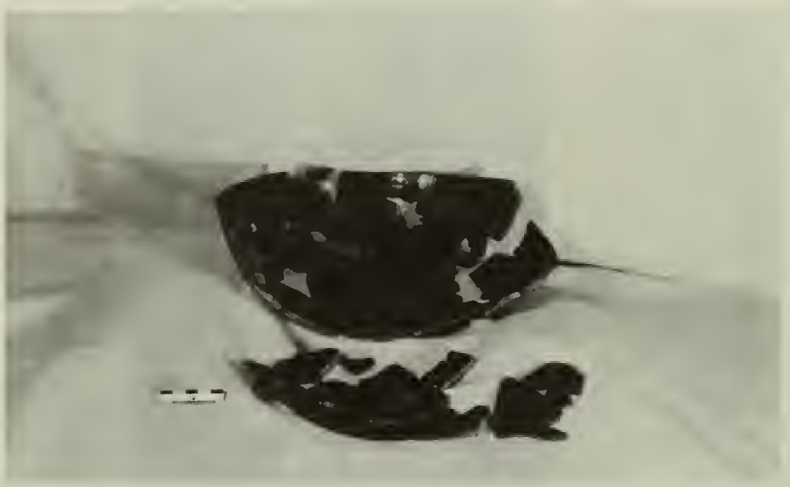
Chaco McElmo Black-on-white (Plates 1.8, 1.9). This is the only type presently officially included in the Cibola series with carbon paint. The wall thickness, slip, slip-slop, and paste of this type affiliate it with Chaco Black-on-white and the other Cibola types. Subjectively, the

A

B

C

Plate 1.5. Vessels from Kivas 13 and 15.
A. Gallup Black-on-white pitcher.
B. McElmo Black-on-white bowl.
C. Black Mesa Black-on-white bowl.



A

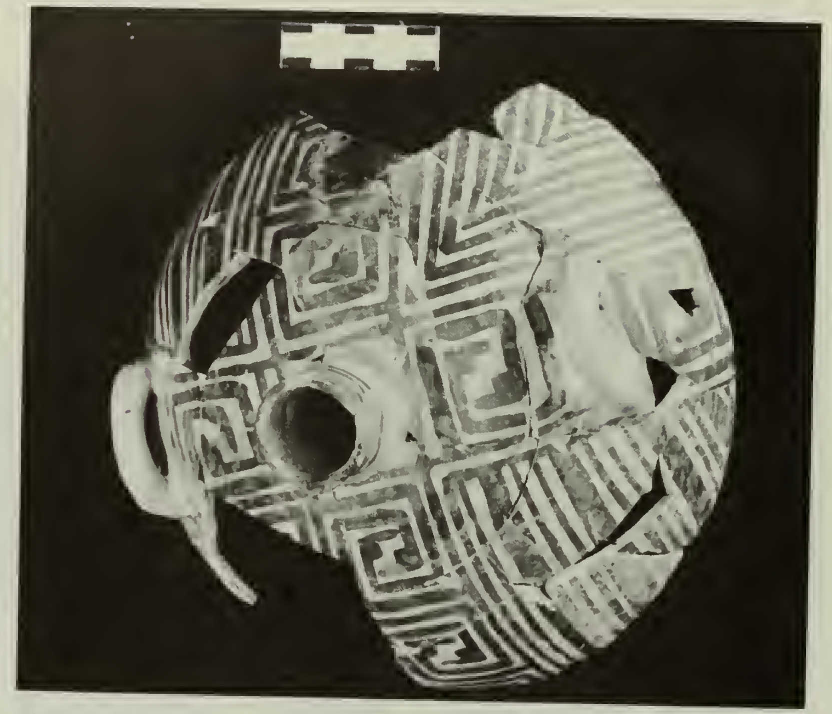
B

Plate 1.6. Vessels from Trash Mound Test Trenches 1 and 2.
A. Forestdale Smudged bowl.
B. Gallup Black-on-white bowls.

A

B

Plate 1.7. Vessels from Trash Mound, Plaza 1 test and Other Structure 7 wall clearing.
A. Miniature culinary pitcher and Gallup Black-on-white bowl.
B. Puerco Black-on-red bowl.



A

B

Plate 1.8. Chaco McElmo vessels from Room 146 and surrounding proveniences.
A. Chaco-McElmo Black-on-white canteen.
B. Chaco-McElmo Black-on-white olla.

Plate 1.9. Restored vessels from wall clearing--Rooms 221, 233, and Plaza 1.
A. Chaco-McElmo Black-on-white olla.
B. Mancos Black-on-white olla.
C. Reserve Black-on-white bowl.

polish on Chaco McElmo seems a bit higher than in the other types, but this may result in part from the visual effects of carbon paint. Designs are very different from Gallup--hachure is not known in this type and rims are squarish and are ticked a little less than half of the time. Broad lines concentric to the vessel rim are a common design, as are dotted checkerboards. Both Sosi and band designs are present. Chaco McElmo is characterized by finer execution of design than San Juan McElmo. Although some design and rim decoration is reminiscent of Mesa Verde Black-on-white, on Mesa Verde the slip is thicker and tends to cover both surfaces of bowls, external designs are more common and vessel walls much thicker; rim ticking in Chaco McElmo is small dots whereas Mesa Verde Black-on-white is more boldly and variably ticked. The estimated production span of Chaco McElmo is quite brief--A.D. 1100-1150.

Pueblo II-III Carbon-on-white (Plates 1.5, 1.10). This is clearly a catch-all type. Sherds exhibiting carbon paint are relatively rare in association with Red Mesa and Gallup ceramics in Chaco. Carbon-painted sherds from these contexts fall into three main categories: holdover BMIII-PI vessels that are fairly easily distinguished and placed into a group with that label; contemporary Chuskan ceramics that can also be recognized more often than not and placed into one of those categories; and Tusayan whitewares, for which there is also a rough-sort category. Later carbon-painted wares cause much more difficulty. Finish and design of such later types sets them apart from the very early carbon wares, but placing them in traditional types produces the sort of haggling and indecision that the rough sort was intended to avoid--hence the lumped group.

As will be partly inferred from the temper of this group (Table MF-1.4) vessels placed in this type likely came from a variety of sources. Were more traditional types used, they would include the following:

(1) McElmo Black-on-white from the Mesa Verde Whiteware series, tempered either with San Juan igneous (7.4 percent of the Alto PII-III C/w group has this temper) or some unknown percentage with sand and sherd temper.

(2) Chuska types, primarily Toadlena and Nava Black-on-white--22.3 percent of the PII-III Carbon-on-white group, have trachyte as the dominant temper. The Chuska carbon paint series suffers a peculiar division in this collection of types--that is, Newcomb/Burnham are given the category Chuska carbon with Red Mesa design, Chuska Black-on-white is given its own type, and "Chuska whiteware" includes Toadlena, Nava, other Chuska carbon types, and unclassifiable Chuskan items. Still, items not readily identifiable with the naked eye as Chuskan but likely to be Chuskan, based on microscopic examination, are also placed in PII-III Carbon.

(3) Possibly a more local, carbon-painted ware, in essence Chaco McElmo, lacking some combination of the line precision, high polish, slip-slop, thin hard walls, squared ticked rim, having sand, sherd and sand, or more sandstone than trachyte. Franklin (1982:17-19) calls such a group Cibola Carbon-on-white.

A

B

Plate 1.10. Vessels from Room 103.
A. Tusayan Black-on-red jar.
B. Chaco-McElmo Black-on-white canteen.

(4) Rare carbon-paint types such as representatives of the Little Colorado whiteware series.

(5) Perhaps, but not probably, stray, carbon-painted types from elsewhere, such as Tusayan whitewares.

Because this is an inclusive group, an estimated production span is riskier than usual; McElmo and Nava seem to extend to around A.D. 1275 (Breternitz et al. 1974; Windes 1977), whereas Toadlena may have lasted only until A.D. 1125. For the "type" as found at Pueblo Alto, it is likely that most antedates A.D. 1200 and postdates A.D. 1100.

Hachure Development. Early development of designs proceeded from isolated designs to designs along continuous lines bisecting or quartering a vessel, then to designs pendant from rims, then to predominately band designs by Red Mesa. Through time the increasing importance and diversity of closed whiteware forms can be seen to contribute to the change from isolated and rim-oriented designs to band designs. Subsequent to Red Mesa there is yet another design layout shift in which decorative fields are filled in a more complex fashion and during which time there is a florescence in the use of hachure. Hachure is an especially intriguing method of decoration because of its cooccurrence with the Classic Bonito portion of Chacoan prehistory. After scant use in basketry and the earliest painted Anasazi ceramics, the use and varieties of hachure gradually increased through time. Basketmaker ceramics from 29SJ 628 (Toll and McKenna 1980) suggest that hachure occurred as less than 5 percent of the decoration. Hachure in Red Mesa occurs as about 5-10 percent of the decoration (Toll and McKenna 1981 and this report). The aggregate of mineral-on-white types contemporaneous with Gallup Black-on-white (Puerco-Escavada-Gallup) reaches 58 percent hachured at Pueblo Alto. In the carbon-on-white pottery that appears after A.D. 1100, hachure is virtually absent.

As indicated, the typology employed by the Chaco Project makes type distinctions based on hachure styles (Figure 1.5). Roberts (1927) established a system similar to this one but technically not equivalent across the board with the current Cibola types. Roberts (1927) defines his three hachure types as follows:

Hachure A: "Widely spaced, rather heavy composing lines, either straight or squiggled in tendency; generally although not always the framing lines are rectilinear; a considerable use of solid elements in combination with, or as opposing factors of, the hachured lines.

One of the earliest forms of Hachure A...shows widely spaced, heavy and often squiggled composing lines in associa-with solid figures." (p. 170)

Hachure B: "The composing lines are still rather widely spaced but the framing lines become quite heavy. This results in a form of the hachured designs which...is always pictured as the typi-

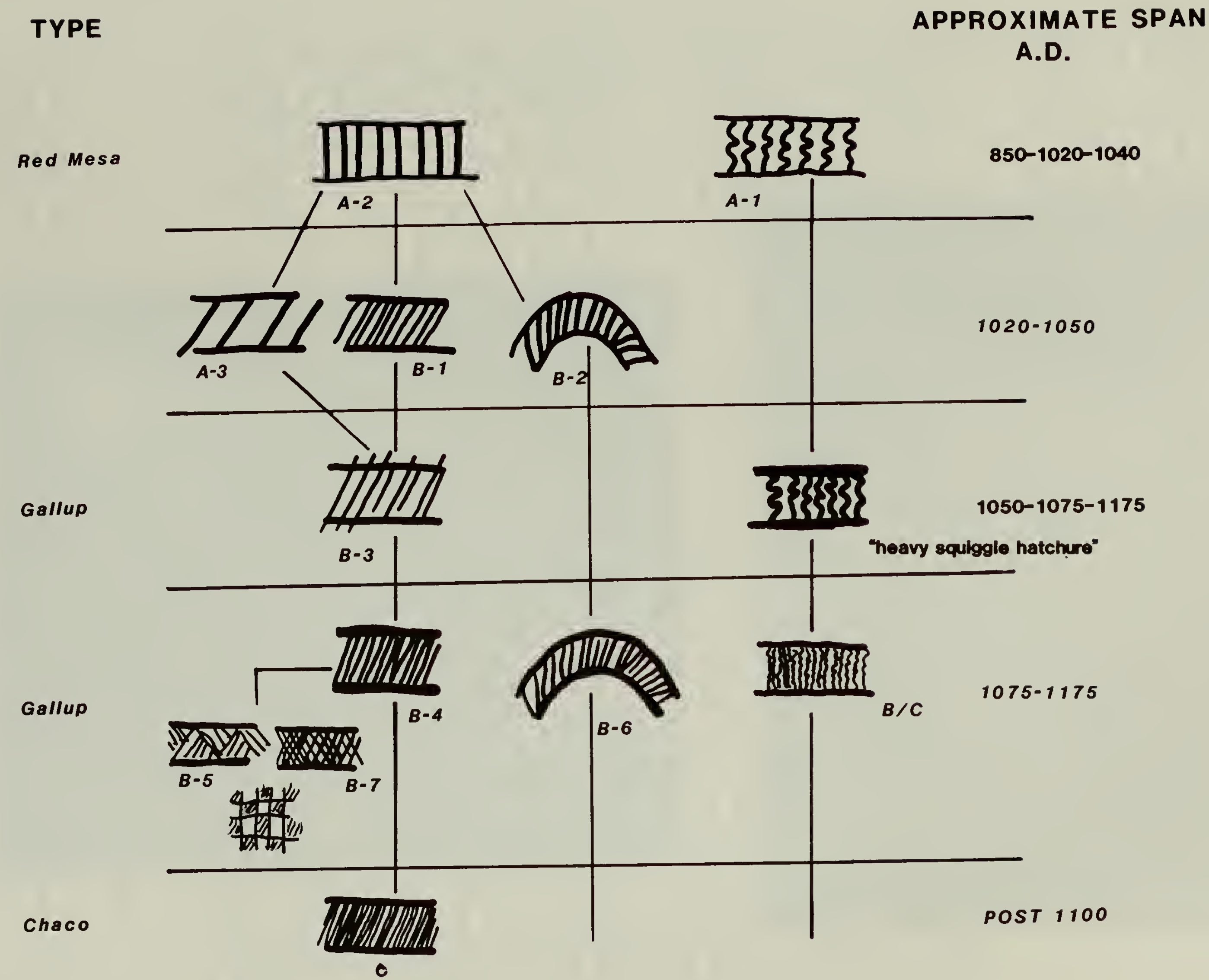


Figure 1.5. Schematic development and chronology of hachure in Chacoan Cibola whiteware.

cal feature of this decoration in the Chaco Canyon. There is to be observed a certain tendency to the survival of the shaded tips.... The main outlines of the decoration may be either rectilinear or curvilinear." (p.174-175)

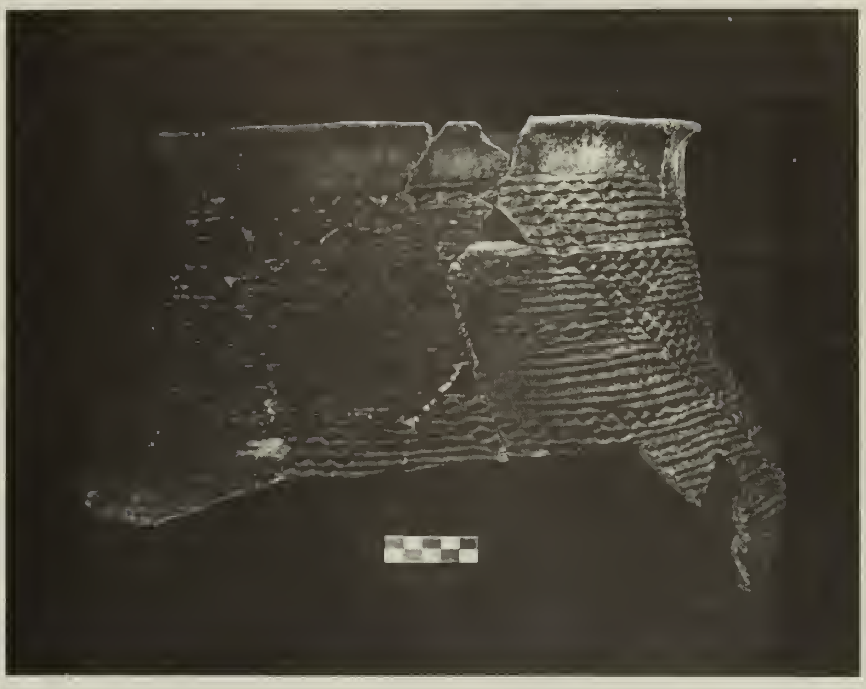
Hachure C: "... the chief point of differentiation between the C group and the preceding forms of the hachured designs was in the tendency to make the lines of the decoration vertical and horizontal to the lines of the vessel upon which it was painted. Another feature lies in composing lines which are finer and more closely spaced than in the A and B groups. There are no solid elements in combination with the hachured ones and no shaded tips." (p. 180)

From these definitions it can be seen that motif itself is not the basis of differentiation but rather the design orientation on the vessel. Clearly, Roberts also saw that oblique, closely spaced, straight-line hachure between heavier framing lines was later than the earlier, heavy, squiggled, and line-width-indiscriminate hachures. Also part of this trend was a reduction in the number of hachure/solid-motif combinations. The vessel orientation of Roberts' system is clearly not practical for sherds. Thus, while Roberts recognized and described the design changes used by our typology, the criteria he emphasized are different. Figure 1.5 shows the types of hachure recognized by our analysis and how they relate to Roberts' system, our types, and time.

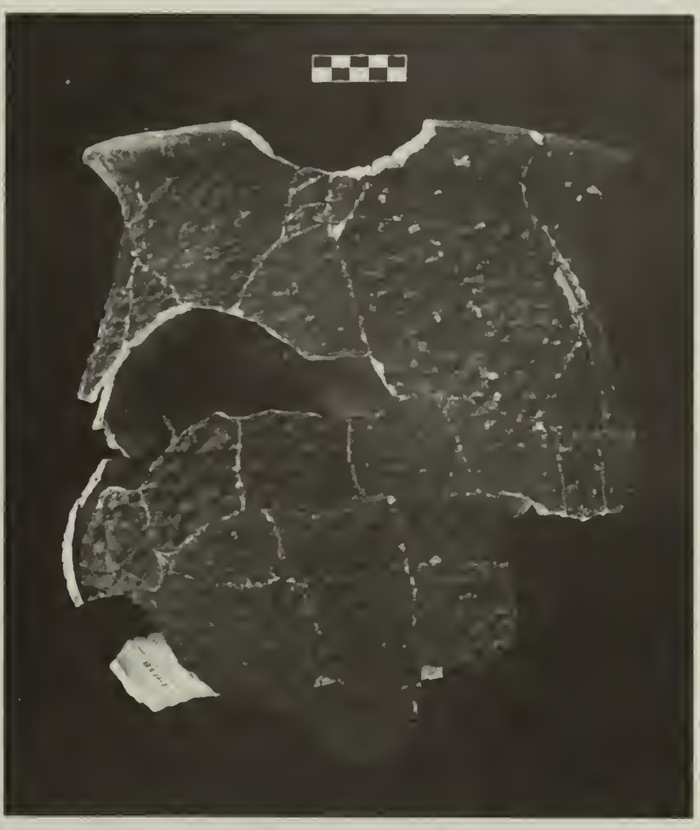
Graywares (Plates 1.3, 1.11). As discussed more fully below, graywares have not been placed in standard types, but, rather, in broader groups and studied on that basis. Because temper is a primary determinant of most graywares in this time period, it is possible to arrive at approximate type counts from these results, though there is some loss of subdivision. Following the neckbanded and neck corrugated groups, the bodies of most Anasazi graywares are completely indented corrugated. The main criterion for placing items in the groups PII, PII-III, and PIII corrugated is a subjective assessment of rim flare--PII rims are straight to slightly flared, PIII rims markedly everted, and PII-III rims intermediate. Rim flare was also measured, but the appearance, not the measurement, was used to assign items to groups. PII corrugated is assigned to the period A.D. 975-1125, though there are significant difficulties in identifying the early end from sherds because of the cooccurrence of neck corrugated with overall corrugated. PII-III corrugated is estimated to have been produced between A.D. 1100 and 1200.

Recording Problems and Procedures in Design Analysis

Painted designs have traditionally received more attention than other attributes and form the basis for the majority of type assignments here. Recording something as variable as design is difficult to do systematically. At the time of its establishment, the approach taken in this analysis did not have the benefit either of well thought-out approaches (such as Plog 1980a) or of the experience of having used the system for ceramics



A



B

Plate 1.11. Grayware vessels from Room 103.
A. Chaco Corrugated jar.
B. Hunter Corrugated jar.

from several time periods for both recording and write-up. The rudiments of design recording here were to record up to three "designs" per item from a list of 69 painted items and 22 varieties of surface treatment (mainly corrugations). The system's two primary problems are, first, that various of the codes represent aspects of painted design that are very different but are given equivalent status and, second, that it is difficult even with the computer to examine cooccurrences of designs on single sherds.

Of more importance to understanding the results is how the system treats aspects of painted design; such an understanding requires a sally into the realm of terminology. We understand there to be a hierarchy of concepts something like the following, much as laid out by Colton and Hargrave (1937:14-17).

(1) Elements--minimal shapes that are the components of the more complex levels below. Elements can vary widely in complexity, and at the upper end it becomes a value judgment as to whether a figure is a complex element or a motif. For present purposes, a figure is still considered an element even if a number of "secondary units" (Plog 1980a) are appended to or included inside the primary form. Thus, a solid painted, stepped figure with projecting dotted lines is an element in spite of its complexity.

(2) Motifs--two or more elements used in relationship to one another, forming a unit that may be repeated; the relationship between component elements should be considered in terms of juxtaposition of complete elements rather than accretion of secondary elements.

(3) Design--use of elements and motifs on a vessel to fill the decorated field.

(4) Style--a recognizable constellation of designs that is similar in layouts, motifs, and elements; Colton and Hargrave (1937:14) specify that recognizable manner of use of "a certain given [sic] element, motif, or pattern must occur on two or more pottery types" to be a "Style of Design."

Clearly, the above is not a strict hierarchy, nor is it inclusive. Colton and Hargrave--upon whose system we still heavily rely--recognize the lack of hierarchical structure in the above quotation. No attempt at design analysis of which we are aware has succeeded in devising a strictly objective ordering that covers all aspects of design. Washburn (1977) is frequently cited (e.g., Plog 1980a; Redman 1978) for having created an objective, systematic system, but that system applies only to design symmetries recognizable only on vessels or very large sherds. When dealing with design components rather than symmetry, Washburn, too, reverts to elements and motif lists. Plog's (1980a) approach designates forms (equal to elements above) and then specifies types of filling (solid, hatched, etc.) and appended forms. Although there are some problems with such things as whether a line is the same as a rectangle in concept, this approach seems sensible and more easily used than ours and others.

It should be stressed that this hierarchy is a statement of our idealized view of ceramics, and that it is not the same as our actual behavior. That is, the coding system does not compartmentalize various aspects of ceramic design but, instead, draws from an undifferentiated pool of codes. In looking at the above hierarchy of terms one naturally wonders where several concepts not included would fit. A few of these are discussed below.

(1) Fillers--geometrical elements may be filled in a number of ways, solid paint and hachure being the primary ones in Chacoan ceramics. Our system combines both form and filler, but in an inconsistent fashion. That is, some codes represent form, fill, and appended forms whereas others represent only fillers.

(2) Appended forms--Plog (1980a:47-53), drawing from Carlson (1970), terms elements such as dots, flags, and ticking added to the primary designs "secondary units." Again, the present system is inconsistent in its treatment of such units--some are subsumed under the form to which they are appended, some are distinct codes, and others are implied.

(3) Types--even (or perhaps especially) this widely used concept is variable in its relationship to the hierarchy set forth, as is often lamented (e.g., Plog 1980a; Washburn 1977). Thus, a filler such as Hachure C (very fine hachure with heavier framers) in mineral paint is almost all that is needed for assignment of the type Chaco Black-on-white (though surface treatment may contribute to the assignment), whereas style, design, surface treatment, and paint are required for other types and, in some cases, are still ambiguous. The problems encountered by all those who have attempted to create design hierarchies and systematic typologies point again to the multivariate nature of design, and, on the next level, ceramics. Neither can be dealt with in a strictly hierarchical, monothetic and yet still workable fashion. Our approach is less than optimal, but recognizing the need for a polythetic understanding of more or less continuous variation (see Clarke 1968:668; Hill and Evans 1972:262-265), we present data showing variation on several variables and, to some degree, covariation of selected variables.

The problem of difficulty of manipulation is more mechanical and is, in part, a function of the large number of variable states (elements, designs) and possible combinations. In recording, design codes were not ordered past an unstated, general, and not always followed rule that the first code is the primary element present. The lack of ordering means that, while combinations (i.e., cooccurrences of designs no matter what the order) are of interest, codes potentially occur in permutations, which are a great deal more numerous.

There are potentially 314,364 permutations of 69 designs taken 3 at a time (i.e., 3 designs would make one combination of 3 but 6 strings of computer code--permutations--that are unique as far as the computer is concerned); the number of combinations of 69 codes taken 3 at a time is a mere 52,394. This figure does not include the lack of design as a possible element, though sherds were frequently coded as having only one or two

designs. Including cases with one or two motifs adds another 2,415 possible combinations (69 designs in combinations of 2, plus 69 designs used alone). Given this recording system, to determine the occurrence of single combinations would require extensive, expensive substringing and sorting on the computer. On the other hand, many designs either cannot occur together or are very unlikely to do so, which reduces both permutations and combinations for practical purposes.

The primary decorated types from Pueblo Alto exhibit nowhere near the theoretically possible number of permutations of designs, which should approach the number of items in each type under random use of design, given samples the size of those we have and the large size of the permutation. Design element use is, of course, not random, especially within design-oriented types. In view of that fact and the fact that some order was entered in recording, it is somewhat surprising how many permutations appear to occur only on single sherds. The lack of duplication is especially apparent in sherds coded for two and three designs. Table 1.7 shows permutation distributions within types.

Some combinations are repeated in more than one permutation (e.g., scroll-hook-star and hook-scroll-star are two permutations and one combination), but the incidence of this is fairly low (e.g., inspection of the moderately sized Escavada group shows three combinations were each found as two permutations of two elements involving two, four, and five cases). It is quite clear that three-element permutations are very rarely found on more than one sherd per type, and if so, only on two sherds. Permutations of 2 elements also repeat relatively infrequently in samples of this size --only in Red Mesa and Gallup (the 2 largest groups) are there more than 10 sherds per permutation with 2 designs. As can also be seen from the descriptive tables (MF-1.1, MF-1.2, MF-1.4 to MF-1.15), each type has a few elements that account for a large percentage of the type; further, these elements occur singly in a large percentage of the cases. See also the summary Tables 1.8 to 1.12.

The problems noted for the design recording system raise more than just analytical difficulties. There is, in addition, the much more mundane dilemma of just how to refer to the various phenomena recorded and tallied. A subjective census of the list of codes was taken with the following results.

elements--12 (includes some secondary)
motifs--10
element or motif--17
motif or style--3
motif or design--2
element, motif, or design--16 (includes all hachures)
element or style--4
locations (bowl exterior or jar neck)--3
catchall--1

Not included in the census are painted culinary, slip distribution, and all varieties of culinary surface treatment. The census shows quite

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Table 1.7. Occurrences of design permutations in primary decorated types, Pueblo Alto.

Type (n)/ Designs per sherd	SHERDS PER PERMUTATION one	2-4	5-9	10-19	20-39	40-59	60 +	Total
Red Mesa (314)/								
one	6	4	6	4	1	1		22
two	50	24	1	1				76
three	17	2						19
Totals	63	30	7	5	1	1		117
Escavada (142)/								
one	6	4	6	2				18
two	41	3						44
three	13							13
Totals	60	7	6	2				75
Puerco (284)/								
one	3	7	3	3	3			19
two	60	9	1					70
three	26							26
Totals	89	16	4	3	3			115
Gallup (1,041)/								
one	3	3	1	1	3	1	5	17
two	88	30	8	2				128
three	25	1						26
Totals	116	34	9	3	3	1	5	171
PII-III Carbon/w (96)/								
one	10	8	1	3				22
two	15	1						16
three	5							5
Totals	30	9	1	3				43
Chaco McElmo (77)/								
one	5	2	3	2				12
two	15	1						16
three	5							5
Totals	25	3	3	2				33

Table 1.8. Pueblo Alto Escavada Black-on-white design elements constituting more than 2% of type inventory.

Designs	Motif Number 1	2	3	n	% of total
parallel lines	10	2		12	5.5
pendant parallel lines	9	2		11	5.0
scrolls	3	8	2	13	6.0
dotted lines	2	4		6	2.8
checkerboard	15			15	6.9
sawteeth	10	3		13	6.0
barbs	9	4		13	6.0
wide Sosi style	17	3	1	21	9.6
narrow Sosi style	6		1	7	3.2
heavy curvilinear lines	9	1		10	4.6
solid band design	14	4		18	8.3
general solids	12	8		20	9.2
solid ticked triangles	2	3	1	6	2.8
Total designs >2%	118	42	5	165	75.7
Total	142	63	13	218	
n w/ 1,2,3 designs	79	50	13	142	
% w/ 1,2,3 designs	55.6	35.2	9.2		

Table 1.9. Pueblo Alto Puerco Black-on-white design elements occurring as more than 2% of type inventory.

Designs	Motif Number 1	2	3	n	%
parallel lines	6	6		12	2.8
scrolls	7	9	1	17	4.0
checkerboard	31	1		32	7.9
sawteeth	15	7		22	5.2
barbs	29	8	3	40	9.4
elongated scalloped triangle	12	2	1	15	3.5
wide Sosi style	35	11	1	47	11.1
narrow Sosi style	9	3		12	2.8
heavy curvilinear lines	11	1	2	14	3.3
solid band design	44	8		52	12.2
general solids	29	11		40	9.4
solid ticked triangles	27	5	1	33	7.8
motif on bowl exterior		7	3	10	2.4
Total designs >2%	255	79	12	348	81.9
Total	284	115	26	425	
n w/ 1,2,3 designs	169	89	26	284	
% w/ 1,2,3 designs	59.5	31.3	9.2		

Table 1.10. Pueblo Alto Gallup Black-on-white designs constituting more than 2% of total.

Designs	Motif Number 1	2	3	n	% of total
corner triangles		45	8	53	4.0
hatched band motif	19	13	1	33	2.5
general solids	5	30	1	36	2.7
hachure B-1	173	18		191	14.3
hachure B-3	121	3		124	9.3
hachure B-4	297	14	1	312	23.4
hachure B-6	68	11		79	5.9
hachure B/C	95	7		102	7.6
hachure C	37			37	2.8
hatched checkerboard	39	11	1	51	3.8
other hatched	88	6		94	7.0
Total designs	942	158	12	1,112	83.2
Total	1,041	267	28	1,336	
Total w/ 1,2,3 designs	774	239	28		
% w/ 1,2,3 designs	74.2	23.0	2.7		

Table 1.11. Pueblo Alto Chaco McElmo Black-on-white designs constituting more than 2% of total designs.

Designs	Motif Number 1	2	3	n	% of total
parallel lines	12	1	2	15	14.9
scrolls	2	2	1	5	4.8
dotted checkerboard	4	1		5	4.8
checkerboard	1	1		2	1.9
barbs	11	3		14	13.5
wide Sosi style	18	3		21	20.2
narrow Sosi style	6	1		7	6.7
solid band design	4	2		6	5.8
general solids	8	2		10	9.6
interlocked frets	2	1	1	4	3.8
Total designs >2%	67	16	4	87	83.7
Totals	77	22	5	104	
Total w/ 1,2,3 designs	55	17	5	77	
% 1/ 1,2,3 designs	71.4	22.1	6.5		

Table 1.12. Pueblo Alto Pueblo II-III Carbon-on-white designs constituting more than 2% of the inventory.

Designs	Motif Number 1	2	3	n	% of total
parallel lines	11	2		13	10.6
pendant parallel lines	3	3		6	4.9
scrolls	2	3		5	4.1
dotted lines	3	1		4	3.2
checkerboard	2	1		3	2.4
sawteeth	2	2	2	6	4.9
barbs	1	2		3	2.4
wide Sosi style	14	1		15	12.2
narrow Sosi style	5	1		6	4.9
heavy curvilinear line	3	1	1	5	4.1
solid band design	13	1	1	15	12.2
general solids	19			19	15.4
hachure A-3	3		1	4	3.2
Total designs >2%	81	18	5	104	84.6
Totals	96	22	5	123	
n w/ 1,2,3 designs	74	17	5	96	
% w/ 1,2,3 designs	77.1	17.7	5.2		

graphically how broad a number of the codes are. Strictly speaking then, any reference to the items coded should be in terms of "codes" or something equally vague and general. However, having recognized the slackness of the system, we beg an indulgence to speak of these "coded decorative items" as elements, motifs, and designs. Wherever these terms are used in the strict sense it will be so indicated.

Design Occurrence in Types at Pueblo Alto

Layouts

One of the best cures for some of our system's ailments would be to have a separate code for design layout. A few of the design codes used are the equivalents of such a code: solid band design, hatched band design, and Sosi style with wide and narrow lines (two codes). Not surprisingly, these codes are freqently used. Their occurrence is of interest in examining the use of design through time and across types. The most frequent "motif" in both Puerco and Red Mesa at Pueblo Alto is solid band design, whereas in Escavada and Chaco McElmo it is Sosi style using wide lines. These two codes are very general and both cover two design aspects: types of element present and layout of design. The two layouts are mutually exclusive in this system and, as indicated above, show change in relative frequencies in the Pueblo Alto ceramics, especially in the Cibola Chaco series. Combining the wide- and narrow-lined varieties of Sosi and the hatched and solid band designs, the following progression in design use is apparent:

	Red Mesa	Escavada	Puerco	Gallup	Chaco McE.	PII-IIIC/w
% Banded	22	10	13	2	6	12
% Sosi	5	13	15	1	34	17

By definition neither solid band nor Sosi design is likely to be found in Gallup, but Sosi layouts are similar to the nonband layout often found in Gallup. Further, "hatched band design" (2 percent of Gallup's motifs), a hatched counterpart to solid band design, is rare but present in the other mineral-painted types. Therefore, whereas Gallup Black-on-white is a distinctive group in its use of hachure variants, it has many affinities with the other types under discussion:

both groups show use of both band layouts and Sosi-Dogoszhi layouts;

both groups make use of the same design elements, though in different proportions; and

there is a gradual but never complete shift from the use of band to field-filling, "running panel" (Colton and Hargrave 1937:16), more-or-less helical layouts.

The nonband, "new" approach to covering the design field is most highly developed in Gallup, but is often seen in solid elements in Puerco.

Because these layouts are sometimes very intricate, it is necessary to have larger portions of vessels to identify them, and they are more difficult to pigeonhole than are band designs. This partly explains why the present system is underdeveloped in the way it is--it was designed to deal with sherds. The elements appearing important in Gallup are hachure types, and the layout can only be inferred. Band layouts are indicated in Gallup, but only for 2.5 percent of the inventory. Dogoszhi style is minimally defined (Colton and Hargrave 1937:16) as hachured elements in running panels but is widely recognized; Gallup falls within this style. In addition to the layouts mentioned, Gallup shows quartered fields which are at best uncommon in other types. Note that the quartering of field seen in Gallup is different from that found in BMIII-PI types in that the latter quarter the field with a narrow design, whereas in Gallup the quarters tend to be filled with repetitions of a motif.

Specific Motifs

As there is some sharing of layouts between types, many "motifs" are also found in several types. In the Pueblo Alto sample, 13 design codes were recorded in each of the 6 types presented in detail. Parallel lines, pendant parallel line, ticking, scrolls, eyed solids, barbs (Flagstaff style), heavy curvilinear line, checkerboard, and dotted lines all may be considered elements and motifs.

Sosi design with wide lines and Sosi design with narrow lines are both styles of layout and line use.

General solids and jar neck motif specify very little. The former indicates an unidentifiable, solid-filled element, and the latter specifies mostly a location--on many jars and ollas the neck decoration is unrelated to the main body design.

As will be seen below, the frequency of use of these designs in the different types is highly variable. Only the least informative--general solid--constitutes more than 2 percent of all six types' inventory. Scrolls and parallel lines each are more than 2 percent of all types except Gallup, which does not use any of the other "universals" in more than 2 percent of its inventory. All of the solid-element types except Red Mesa use barbs as an important element, and all except Chaco McElmo use checkerboard (Chaco McElmo emphasizes a related motif, dotted checkerboard). Red Mesa, Escavada, and PII-III Carbon-on-white frequently use pendant parallel and dotted lines; Escavada, Puerco, and Carbon-on-white make frequent use of heavy curvilinear lines. Of the other element/motif "universals," ticking and eyed solids both occur as less than 2 percent of all the types' inventories; however, solid ticked triangles are more than 2 percent of the Red Mesa, Escavada, and Puerco designs.

The coefficient of Jaccard (S_J) (Sneath and Sokal 1973:131-2) is a simple method of rating similarity between groups on the basis of nominal attributes. It is calculated as follows:

		Type A present	Type A absent	total
Type B	present	a (present in both)	b (B only)	x
	absent	c (A only)	d (absent)	
		y		n

$$S_J = a/a + b + c \quad \text{or} \quad a/(x + y) - a.$$

It should be pointed out that this index deals strictly with cooccurrence of motifs, not with quantity thereof. Thus, a motif that occurs once in each of two types counts the same as one that occurs 100 times in one type and 50 times in another. Two compensations have been made for this drawback: percentages within each type were summed for those motifs that are common to another type (Table MF-1.16), and both procedures were conducted for those motifs that constitute 2 percent or more of each type's inventory of designs (Table 1.13).

The coefficient of Jaccard is useful for ordering the degree of similarity of one type to others within the same collection. It cannot be used, however, to make cross-pair comparisons such as "Escavada and Puerco are more similar to one another than are Gallup and Red Mesa," because the numbers of motifs in individual types vary. Note that this is quite different from saying "Red Mesa is more similar to Gallup than it is to Puerco." Thus, Chaco McElmo, represented here by a small sample, shows a lower S_J with PII-III Carbon-on-white (.581) than does Escavada with Puerco (.604), even though 85.7 percent (18 of 21) of Chaco McElmo designs are present in PII-III Carbon-on-white while only 78.4 percent (29 of 37) of Puerco designs are present in Escavada. The discrepancy results from the smaller number of motifs found in this sample of Chaco McElmo. The coefficient does not measure motifs not present in either type in a pair, which is appropriate when the full range of occurrence of motifs is not known. Practically speaking, the list of named designs is finite, and the number of designs not present in either of two types is calculable. However, because of sample sizes, and because the coefficient as established ignores the negative-negative cell (d above), it is not calculated here. There is a correlation between the number of designs coded for a type and the size of the sample of the type, though the number of additional designs may begin to level off with samples of around 200 motifs (see Table MF-1.16).

The effect of smaller numbers of designs being compared with larger is to substantially reduce the maximum possible value of S_J. The maximum possible value of S_J for a given comparison may be calculated by dividing the smaller number of occurrences by the larger. If the numbers of designs are equal, the maximum value is one, but, for example, in a comparison of the inventories of Chaco McElmo (21 designs) and Escavada (40) here, the maximum S_J is .525, if all the Chaco McElmo designs are found in Escavada. Again the problem of "missing" designs is relevant—that is, it may be an important aspect of a type that it exhibits a small

Table 1.13. Motif co-occurrence in Red Mesa, Puerco, Escavada, Chaco McElmo, PII-III carbon, and Gallup at Pueblo Alto; painted motifs constituting 2% or more of each type's inventory only.[a]

A. Numbers of types sharing motifs and percents of total motifs

Types (n of motifs)	TYPES IN COMMON 4	3	2	1	none	Total%
Red Mesa B/w (12)	4	2	3		3	
% accounted for[b]	42.5	7.2	21.6		11.9	83.2
Escavada B/w (12)	4	4	4			
% accounted for	25.7	21.1	38.0			84.8
Puerco B/w (12)	4	4	2		2	
% accounted for	24.7	37.6	12.5		6.7	81.5
Gallup B/w (10)					10	
% accounted for					84.0	84.0
Chaco McElmo B/w (8)	4	2			2	
% accounted for	35.8	38.0			9.7	83.5
PII-III Carbon/w (12)	4	4	3		1	
% accounted for	38.2	26.4	10.8		3.9	79.3

B. Percentages shown are % accounted for

Types (motifs)	NUMBER OF SHARED MOTIFS Red Mesa	Escavada	Puerco	Gallup	Chaco McElmo	PII-III Carbon/w
Red Mesa (12)		9	7	0	4	8
% of column type		51.9	47.9	-	35.8	56.8
% of Red Mesa		71.3	62.3	-	42.5	58.7
Jaccard's		0.600	0.412	0	0.250	0.538
Escavada (12)	9		10	0	6	11
% of column type	71.3		74.8	-	73.8	79.3
% Escavada	51.9		65.8	-	43.2	71.4
Jaccard's	0.600		0.714	0	0.429	0.846
Puerco (12)	7	10		0	6	9
% of column type	62.3	65.8		-	73.8	69.5
% Puerco	47.9	74.8		-	47.9	66.0
Jaccard's	0.412	0.714		0	0.429	0.643
Gallup (10)	0	0	0		0	0
% of column type	-	-	-		-	-
% Gallup motifs	-	-	-		-	-
Jaccard's	0	0	0		0	0
Chaco McElmo (8)	4	6	6	0		6
% of column type	42.5	43.2	47.9	-		55.8
% Chaco McElmo	35.8	73.8	73.8	-		73.8
Jaccard's	0.250	0.429	0.429	0		0.429
PII-III Carbon/w (12)	8	11	9	0	6	
% of column type	58.7	71.4	66.0	-	73.8	
% PII-III C/w	56.8	79.3	69.5	-	55.8	
Jaccard's	0.500	0.846	0.643	0	0.429	

[a]The "motifs" general solid and jar neck motif are excluded and % calculated.
[b]"% accounted for" refers to the frequency of the shared motif relative to all motifs in the type.

number of designs, as long as that number of designs is not a sample size artifact. Because the correlation between sample size and n of designs is less when 200 or more designs have been identified, comparisons involving those types with samples smaller than 200 should be viewed circumspectly. Table MF-1.16 gives the maximum possible value of Jaccard's coefficient for each pair of types for comparison with the observed values. There is some temptation to "standardize" the S_J values by dividing the observed by the maximum possible values, but that operation assumes that each type draws from the same pool of designs and that is clearly untrue, as demonstrated by the total absence of some designs from the motif inventory in some types.

Gallup, Red Mesa, Puerco, and Escavada from 29SJ 627 were compared (Toll and McKenna 1982, Table 8) using all motifs; the Escavada sample from 29SJ 627 is probably too small to be reliable. At both 29SJ 627 and Pueblo Alto this procedure shows that Gallup has greater similarity to Red Mesa than to Puerco, and Red Mesa has greater similarity to Gallup than to Puerco. Puerco, however, shows a higher coefficient with Gallup than with Red Mesa at Pueblo Alto. This is a surprising result considering that the two types are divided solely on the basis of design elements. The number of different designs recorded for the three comparable types is quite variable at the two sites. The superabundance of Red Mesa at 29SJ 627 meant that 50 designs were identified there as opposed to 39 at Pueblo Alto; since the discrepancy is due to rare designs at 29SJ 627, the diversity of Red Mesa at Pueblo Alto is slightly greater. There are more motifs in the Puerco and Gallup at Pueblo Alto than at 29SJ 627, which is predictable from the greater Pueblo Alto sample sizes in those types.

The comparisons of all decorated types discussed in detail from Pueblo Alto in terms of raw motif occurrence again suggests affinities between Red Mesa and Gallup--understandable through mutual use of hachure; between Puerco and Escavada--separated largely on the basis of polish; and between Chaco McElmo and PII-III Carbon-on-white--both later, carbon-painted groups. A more surprising similarity is that between Escavada and Gallup.

The categorization of an unpolished sherd with hachured elements as either Gallup or Escavada devolves upon several estimates of degree: quantity of hatched relative to solid elements and coarseness (in essence "ugliness") are the two main ones. Another unexpected indication of commonality of design use is that Puerco appears relatively close to Gallup, including the fact that the designs common to the two account for 81 percent of the recorded designs in Puerco. When viewed as amount accounted for, however, 83.4 percent of the Puerco is included in the common designs, whereas only 31.8 percent of the Gallup is included. As will be seen below, this is mostly because the large Gallup sample provided opportunities for the occurrence of motifs uncommon in Gallup but important in other types. Of the mineral-painted types, Escavada shows the greatest similarity of motif use to the two carbon-painted groups, with 90 percent of the Chaco McElmo accounted for by designs found in Escavada (Table MF-1.5).

When elements that constitute at least 2 percent of a type's inventory are compared, the co-occurrences and similarity coefficients are very different from the raw motif comparisons (2 percent was selected because at least three occurrences from the smallest group--Chaco McElmo--are required for the design to be included--Table 1.13). Exterior corrugation, "general solid," and "jar neck motif" have been deleted and the percentages recalculated. The most striking result of this operation is that Gallup shares no "2 percent elements" with the other types. Some indication of the singular nature of Gallup may be seen in Table MF-1.16. Whereas around 80 percent of the other types is accounted for by elements shared with four or five other types, only 21 percent of Gallup is, with 58 percent accounted for by designs not shared or shared with one other type. Chaco McElmo has the same six designs--parallel lines, scrolls, barbs, solid band design, and wide- and narrow-line Sosi--in common with Escavada, Puerco, and PII-III Carbon-on-white, and, because each of these types has 12 2 percent motifs, the similarity coefficients of these types with Chaco McElmo are all the same.

There are four design codes that constitute 2 percent motifs in all types but Gallup; two are "universal" elements--parallel lines and scrolls--and two are more layouts than designs--solid band design and Sosi style with narrow (2-5 mm) lines.

Aside from the major change in relationships from the effective exclusion of Gallup, many of the similarities indicated by raw motif counts are repeated in the 2 percent solution. Escavada remains the mineral-paint type most similar to the carbon types--Escavada and PII-III Carbon show more 2 percent motifs in common than any other pair. Red Mesa, Escavada, Puerco, and PII-III Carbon all have 12 2-percent motifs, allowing ranking of similarity by Jaccard value. On that basis, PII-III Carbon and Escavada are the most similar, followed by Puerco and Escavada, Puerco and PII-III Carbon, Red Mesa and Escavada, Red Mesa and PII-III Carbon, and, finally, Red Mesa and Puerco. This last is reminiscent of the raw comparison, but still unexpected as Puerco is usually thought to have developed from Red Mesa. Red Mesa has three 2-percent motifs not shared with other types, all of which are Red Mesa hallmarks: interlocked ticking, squiggle lines, and hachure A-1. Puerco has two, unshared, 2-percent motifs: exterior bowl motif and elongated, scalloped triangles. Exterior bowl motifs are present in Red Mesa and Gallup (1.2 percent each) but absent in Escavada and both carbon-painted types. The triangle element is present in all four mineral-painted types and is easily considered a variation of ticked triangles common in Red Mesa as well as Puerco and Escavada. Chaco McElmo also has two unique 2-percent motifs--interlocked frets, present in less than 2 percent of Puerco and Escavada, and dotted checkerboard, present only in PII-III Carbon-on- white, again as less than 2 percent.

Vessel Form and Design

It has been found (Bunzel 1929; Friedrich 1977; Plog 1980a) that design use differs from form to form and that it is therefore simplistic

to compare groups without controlling for vessel form. In examination of the Pueblo Alto ceramics for variation of designs on vessel forms, the problem of subdivisions rendering unworkably small samples is a major one (Tables MF-1.1, MF-1.5, MF-1.7, MF-1.9, MF-1.11, MF-1.13, and MF-1.14). In the Escavada, Chaco McElmo, and Carbon groups, for example, the fact that no design code occurs more than 21 times makes testing infeasible. Even in the larger groups, relatively few designs are testable, and considerable lumping of forms is necessary.

However, inspection and the tests possible do permit some observations. The design codes have been lumped, so a single vessel may appear from one to three times in the tables. The percentages of designs by vessel form and percentages of vessel forms are remarkably similar, showing that no form is more likely to have been decorated with multiple designs than any other. Chi-square tests of abundant designs by lumped forms show that some elements occur proportionally to the vessel form whereas others do not (Table MF-1.17). Despite small cells in a test of the five most abundant designs in Red Mesa, no significant difference was found among bowls, ladles, and closed forms. In Puerco, however, checkerboards and band layouts are less frequent than expected on closed forms, whereas Sosi layouts and barbs are more frequent.

In Gallup a test of the eight most abundant codes shows that some hachure variants seem to associate with some forms--pitchers and other closed forms exhibit more than the expected amount of "Gallup/Chaco" hachure and bowls less. Hatched checkerboard is disproportionally represented on ladles and less than expected on closed forms. "Other hachure" tends to be found on bowls in this sample; this code is an ill-defined catchall, and its preponderance on bowls may be due to small sherd sizes or the high frequency of bowls. As with motifs in types, it is important to note that no design that occurs with substantial frequency is exclusively associated with a particular form, except, of course, for "designs" that occur on particular forms by definition such as "exterior bowl motif" and "jar neck motif." The latter very likely does contain some distinctive designs such as broad, parallel, squiggle lines or parallel lines of increasing length, but the quantification thereof is lost in the confusion of field with design. The tables show that a number of designs were found only on bowls (and rarely other forms), but it is probable that the great majority of these occurrences result from small numbers of other forms.

Vessel Form Occurrence by Type

As has been found consistently at other sites, bowls are without exception the most common form in each whiteware type, but within the Cibola types, the relative frequency of bowls can be seen to decline (Tables MF-1.1, MF-1.5, MF-1.7, MF-1.9). Red Mesa shows the highest percentage of bowls at 78 percent and Gallup the least at 57 percent; with 69 percent Chaco McElmo has a considerably higher percentage of bowls than Gallup. Comparisons of the six types on the distributions of the four forms--bowl, ladle, pitcher, and closed (includes jars, ollas, canteens, seed jars, tecomates, duck pots, and a cylinder jar)--points up some facts about

trends in vessel forms. Red Mesa, Escavada, and Puerco all show no significant difference with the broad group PII-III Carbon, whereas they all differ significantly from Gallup and Chaco McElmo. A large contributor in each of these comparisons is that Gallup and Chaco McElmo each have high frequencies of pitchers relative to the other types. Compared to one another, Gallup and Chaco McElmo are also significantly different, and in this test Chaco McElmo has more than the expected number of pitchers and many fewer than expected other closed forms. Thus, as at 29SJ 627, although pitchers never constitute a high percentage of the form assemblage, they do form an increasingly large portion of the Cibola series types, but not the other later carbon types. Both the carbon and Chaco McElmo groups are a bit small for grand generalizations, but the trend is suggestive of the distinctiveness of the pitcher form for Chaco.

Escavada and Red Mesa show no significant difference, but Puerco differs from both, mostly because of the differences in the frequencies of bowls (fewer in Puerco) and closed forms (more in Puerco).

The 29SJ 627 collection showed distinct differences between Red Mesa bowl diameters and those of Puerco and Gallup, suggesting an increase in size through time. This pattern is present at Pueblo Alto, but is not so uncluttered. Of the six primary types, Red Mesa does have the smallest mean bowl diameter. However, t-tests show that the difference in size is significant only with Escavada and Gallup (Table MF-1.18). The Puerco mean is only very slightly larger than the Red Mesa mean; the only other type pair showing significant difference in bowl diameter is Puerco-Gallup. Although Gallup does have the largest mean, it is not sufficiently larger than the carbon types to differ significantly from them, and Escavada is quite close to the carbons. The means for Red Mesa bowls from 29SJ 629, 29SJ 1360, 29SJ 627, and Pueblo Alto are remarkably similar, ranging from 179.8 to 189.8, showing minute increases through time when 29SJ 629 is considered earliest and Pueblo Alto latest (the Pueblo Alto and 29SJ 1360 means are virtually the same). Pueblo Alto and 29SJ 627 Gallup bowls are very close as well ($\overline{x}$ = 216.5 and 214.1 cm), but the Puerco group mean is considerably smaller at Pueblo Alto than it is at 29SJ 627, which constitutes the one bad note in an otherwise harmonious trend.

Two caveats must be inserted for these diameter comparisons:

(1) The means being compared are in terms of millimeters, which is finer than the level of measurement possible and which is a unit with little functional significance. Measurements are to the nearest 5 mm, and these are largely estimates. The sample sizes are large enough that the size differences are probably real, however.

(2) The within-type frequencies are really fairly similar, as can be seen in Figure 1.6. The weighting of Red Mesa in the smaller orifices and Gallup in the larger is apparent, but that all the types have about the same distribution is even more apparent.

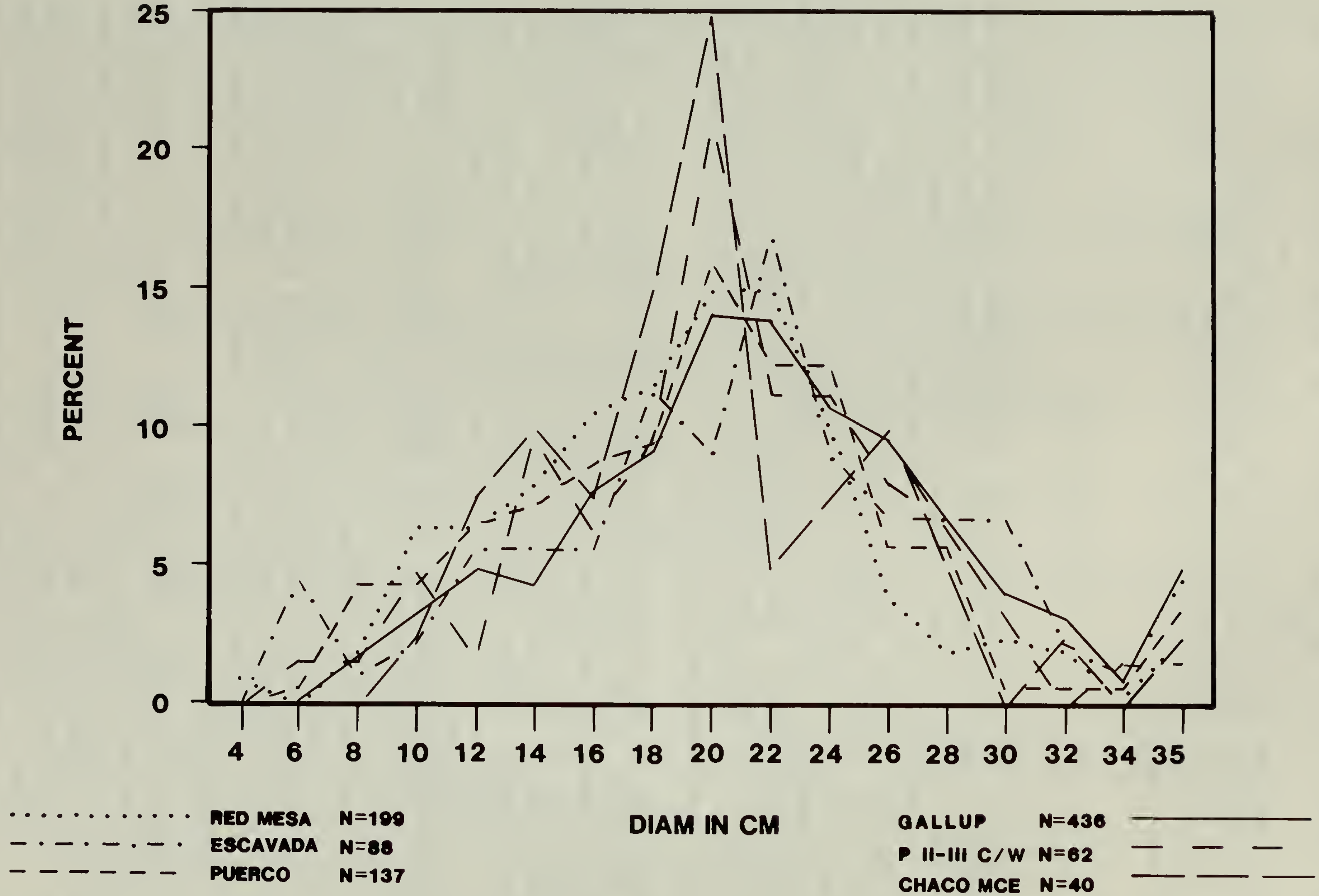

Figure 1.6. Frequency distribution of diameters of whiteware bowls in primary Pueblo Alto types.

Some corroboration of the tendency for Gallup vessels to be larger is found in similar tests of ladles. Once again, Gallup differs significantly from both Red Mesa and Puerco (which are again very close in mean size). In the case of ladles, Red Mesa, Puerco, and Gallup means are all very close when the 29SJ 627 and Pueblo Alto groups are compared (somewhat alarmingly, the Red Mesa means for the two sites are identical), with the Pueblo Alto Gallup group having the largest mean. Other forms are too infrequent to test, but in both pitchers and ollas, Gallup again has the largest mean diameters.

Polish and Slip

Bowls and closed forms, as shown on Tables MF-1.1, MF-1.5, MF-1.7, MF-1.9, MF-1.11, MF-1.13, and MF-1.15, were examined for use of slip and polish (Table 1.14). Through typological time, significant changes take place in the use of slip and polish on the Cibola whitewares at Pueblo Alto. As at 29SJ 627, the greatest difference in this group can be seen between Red Mesa and the later, Cibola, mineral-paint types. Red Mesa bowls tend to be slipped on both surfaces, and as polishing seems to occur on slipped surfaces, both surfaces of Red Mesa bowls are polished compared with the subsequent mineral types where exterior surfaces are more frequently left unfinished. Chaco McElmo, a carbon-paint type, is the most consistent of the Chacoan Cibola types in use of polish on surfaces as it heavily favors the slip-slop style of slipping and complete polishing of all available surfaces on a given form.

Differences in the surface treatment of jars generally follow that of bowls, with those in the temporal group of Puerco-Escavada-Gallup ("Puesga") more diverse than Red Mesa or Chaco-McElmo. Red Mesa jars, like Red Mesa bowls, are usually slipped on both surfaces, and like Chaco McElmo bowls, Chaco McElmo jars are slip-slopped more than expected. The "Puesga" group, although slipped, exhibits all options except treatment of both surfaces on bowls and slip-slop on jars; each type of this composite group presents a different profile in surface treatment. Escavada exhibits higher-than-expected occurrence of no slip or polish, Puerco bowls favor interior or slip-slop slips that are polished, and Gallup is intermediate, exhibiting higher-than-expected levels of interior only and no slips on bowls with these respective surfaces polished. Clearly, it is Escavada, with its lack of surface finishing, that makes these late Pueblo II and Pueblo III Puesga ceramics more diverse than the Red Mesa (Table MF-1.19). And, even though Escavada comprises the smallest type group in this series, it seems sufficiently represented to compose a distinct choice in terms of vessel finish.

Two aspects of polish, the vessel sides possible for treatment and the relative amount of finish, are documented on Table 1.14. Finish is not necessarily related to quality or luster, although some complete finishes are of high quality, but to the actual surface coverage of stone-strokes. Categories of treatment are generally self-explanatory in the subsets of sides or finish, except, perhaps, differential finish which refers to bowls on which the interior is completely polished while the

Table 1.14. Slip and polish distribution on bowls and closed forms for whiteware types in the detailed analysis, Pueblo Alto.

SLIP

	bowls					closed			
	none	int.[a]	sl-sp[b]	both	n	none	ext.	sl-sp	n
Red Mesa	6	79	17	139	241	1	27	4	32
Escavada	23	43	27	10	103	6	10	7	23
Puerco	10	84	45	35	174	3	58	10	71
Gallup	50	283	122	108	563	21	317	45	383
[Chaco McElmo	0	5	39	9	53	0	10	11	21
PII-III C/w	6	15	6	42	69	0	15	2	17
Totals	95	509	256	343	1,203	31	437	79	547
"Puesga"	83	410	194	153		30	385	62	]

POLISH

A. Sides	bowls				closed		
	none	one	two	n	none	one	n
Red Mesa	8	141	93	242	0	30	30
Escavada	49	49	4	102	11	11	22
Puerco	17	135	23	175	3	70	73
Gallup	45	446	80	571	28	352	380
[Chaco McElmo	1	17	35	53	0	20	20
PII-III C/w	3	17	46	66	0	17	17
Totals	123	805	281	1,209		500	542
"Puesga"	111	630	107		42	435	]

B. Finish	bowls					closed			
	none	<total	total	diff[c]	n	none	<total	total	n
Red Mesa	8	16	179	39	242	0	5	25	30
Escavada	49	35	15	3	102	11	7	4	22
Puerco	17	40	116	16	189	3	14	56	73
Gallup	45	83	403	40	571	28	43	309	380
[Chaco McElmo	1	2	45	3	51	0	0	20	20
PII-III C/w	3	3	48	12	66	0	0	17	17
Totals	123	179	806	113	1,209	42	69	431	542
"Puesga"	111	144	534	59		42	64	371	]

[a]int = interior only.
[b]sl-sp = slip-slop.
[c]diff = differential interior-exterior polish.

exterior is polished less than completely. Through typological time the general trend is to the polishing of all available surfaces (dependent on form) and to the complete finishing of those surfaces.

Of the three types included in the temporal "Puesga" group, Puerco Black-on-white has the most diverse bowl-polishing-treatment assemblage. By definition, polish is minimal in Escavada Black-on-white, and Escavada shows higher than statistically expected frequencies of no and less than complete polish on bowls. In this sample, Gallup Black-on-white exhibits more than the expected occurrence of polishing on both sides. Although low-frequency cells are evident in the Chi-square test, it is evident that type trends in jar polishing are similar to bowls.

Pueblo II-II Carbon-on-white constitutes a group similar to "Puesga" in that different types such as Chuskan Nava and Toadlena Black-on-white, San Juan McElmo Black-on-white, and H. Franklin's (1982) "Cibola Carbon" comprise this rough sort group. In this analysis such individual types are not retrievable, and if they were, would not be sufficiently abundant to meet the frequency requirements for detailed description. What unifies this group, besides the temporal aspect, is that, like "Puesga," this group of ceramics is produced within or at the periphery of the San Juan Basin. This places it within the same primary technological and economic "catchment" as "Puesga." It is not surprising, then, that the diversity of slip and polish treatment in the PII-III carbons is similar to the "Puesga" group and markedly greater than that of Chaco McElmo. The main difference in surface treatment between Chaco McElmo and PII-III Carbon-on-white is the tendency of the latter to avoid the slip-slop treatment in favor of slipping both sides and in exhibiting more differential polishing of bowl surfaces similar to the treatment of Red Mesa. There is no significant difference in the amount of polishing between Red Mesa and PII-III Carbon-on-white as both favor total and differential polishing. However, the two do differ significantly in that the carbon-on-white more heavily favors the actual polishing of both surfaces of bowls.

Thus, the distinctions between the blocks of ceramics representing major units of typological time are significant but cycle, with the latest carbon-paint ceramics more closely resembling the earliest mineral type in the current sample. As mentioned, both Red Mesa and the PII-III Carbon-on-white bowls are similar in the surface finishing of bowls. Chaco-Mc-Elmo exhibits such a distinctive and limited pattern of surface treatments as to qualify as the pottery most likely to be of highly restricted area of production (perhaps in Chaco?). A clear increase in the complete finishing of ceramic products is not clear along the typological time line. Gallup frequency controls the "Puesga" group's expected value, and, as Gallup heavily favors slip and polish only on bowl interiors, the trend away from complete treatment of a vessel surface is strong and not dependent on trends in the minority types. In contrast to Chaco McElmo, the high diversity and evenness values of surface treatment in "Puesga" and its constituent types suggest that the "Puesga" period is that of greatest ceramic variation, possibly stemming from multiple sources.

Whiteware Pastes
(Tables MF-1.2, MF-1.4, MF-1.6, MF-1.8, MF-1.10, MF-1.12, MF-1.14)

As at other sites, more than half of each mineral-paint, type group is tempered with sandstone or sandstone and sherd. In addition to the mineral-paint groups, the carbon-paint groups--Chaco McElmo Black-on-white and PII-III Carbon-on-white--have been analyzed for Pueblo Alto; each of these groups contains slightly less than half sand temper. Particularly in the Chaco McElmo group, the temper type trachyte-with-sandstone-dominant occurs in a large number of sherds. As will be discussed, it is likely that these minor occurrences of trachyte result from the introduction of trachyte through sherd temper--treatment of this group as a sandstone temper means that both the carbon-painted groups are more than half sandstone tempered also.

The presence of trachyte temper also follows a pattern found at 29SJ 627, that is, from Red Mesa to Puerco-Escavada-Gallup the overall occurrence increases; over 20 percent of both carbon-painted types is tempered with predominantly trachyte temper. Within the Puerco-Escavada-Gallup group there are marked differences in the occurrence of trachyte. Only one Escavada sherd (1.1 percent of the type's temper sample) and less than 3 percent of the Puerco contain trachyte, whereas the Gallup sample contains nearly 19 percent dominant trachyte temper, thereby approaching the carbon-paint types. In Red Mesa, Escavada, and Puerco the percentages of items coded as having sandstone more abundant than trachyte are larger than those coded for trachyte, the dominant nonsherd temper; the reverse is true for Gallup, Chaco McElmo, and PII-III Carbon-on-white.

The question of where vessels of mixed sand, sherd, and trachyte temper were produced is something of a conundrum. The increase in trachyte-tempered sherds through time in Chaco is well documented, and clearly the availability of sherds containing trachyte for use as sherd temper steadily increased in Chaco. In the Chuska Valley, sherds containing trachyte temper would have been abundant throughout the period in which sherd temper was commonly employed in the region. In a purely probabilistic sense, introduction of trachyte temper was, thus, more likely in the Chuska Valley, except that use of sherd temper there seems to have been somewhat less frequent than it was elsewhere. It might be assumed that vessels tempered with sand-trachyte-sherd mixes were produced in Chaco because sherd temper was the optimal temper available in Chaco and because Chuskan potters would have used trachyte. Quantities of sand in these mixed tempers probably contain a clue as to origin, as use of random sherds for sherd temper in Chaco would be more likely to introduce sand than would a random sample of sherds in the Chuska Valley. Still, sources of sand are many and, at least at this level of analysis, indeterminable; provisionally sherds with more sand than trachyte are less likely to be from the Chuska Valley.

In his study of ceramics from the Coal Gasification Project (CGP) Lease in the Chuska Valley, Windes (1977:310-327) found little sherd temper in the carbon-painted Chuskan types, which concurs with our findings in similar sherds from Chaco. The mineral-painted Chuskan types from the

CGP Lease contained considerably more sherd temper than did their carbon-painted counterparts; and, in the most abundant mineral-painted type, Brimhall Black-on-white (equivalent to Gallup), 19 percent of the sherd temper contained visible trachyte. In contrast to the CGP report, the Chuska mineral-paint series was not recorded as a separate category by the Chaco Project. Sherds that would not fall into the Chuska mineral-on-white types were placed either in Chaco Cibola types, or, for some of the purely trachyte-tempered items, in "exotic mineral-on-white." Windes' placement of sherds in the mineral-painted Chuska series was based on the predominance of trachyte temper as can be seen in his temper counts and according to the type definitions.

Sherds typed as Cibola are largely similar in the Chaco Project and CGP analyses except for temper. Those placed in the exotic mineral-on-white group here would likely be those placed in the Chuska mineral series by Windes, though the temper breakdown of the group exotic mineral-on-white shows that 6 of the 27 (22 percent) trachyte-tempered sherds in the group have more sand than trachyte. Eighteen of the 27 trachyte-tempered items assigned to exotic mineral have hachure designs that would place them in the Brimhall Black-on-white type; Windes found Brimhall to be the most variable in paste composition of the Chuska mineral types, as well as the most abundant.

Tabulating the CGP samples as they would have been recorded in the present analysis can perhaps shed some light on these source assumptions and interpretations. Combining the Brimhall Black-on-white with Gallup, Taylor Black-on-white with Escavada, and Naschitti Black-on-white with Red Mesa from the CGP allows a crude comparison with the temper composition of Gallup, Escavada-Puerco, and Red Mesa from Pueblo Alto. The comparison is coarsened by the "type" exotic mineral-on-white, though the trachyte-tempered members of the group have been divided according to design and added to the appropriate types for purposes of this discussion. If one views these recombinations as representing the composition of a paint tradition in succeeding periods, the Pueblo Alto/Chaco pattern of increase in incidence of trachyte from Red Mesa to Puerco-Escavada-Gallup is reflected in the Chuska Valley, as is the incidence of more trachyte in the hatched types than in the solid-design types. However, the scale is different in the two areas in two senses. First, the recombinations from the Chuska area all exhibit far more trachyte occurrence (in any proportion), ranging from 46 percent to 63 percent; second, the magnitude of the difference is much less through time and between hatched and solid design styles, than at Pueblo Alto.

Although only 37.2 percent of the hachure group at Pueblo Alto (Gallup plus hatched, trachyte-tempered, exotic mineral-on-white) exhibits trachyte in any form (19.8 percent of total is dominant trachyte), this group is clearly the closest to its Chuska Valley analogue. The level of occurrence of trachyte in whitewares found in the Chuska Valley can thus be seen to be very high when it is recalled that 32 percent of the decorated wares is Chuska Carbon-on-white, which is consistently trachyte-tempered (Windes 1977:280).

This mixture of occurrences in different locations indicates that the subject of sherds with trace trachyte in combination with sherd temper is more complex than assuming all trace trachyte came from the sherd temper and, thus, from Chaco. The relative proportions of trachyte more abundant than other material and trachyte less abundant are reversed between Chaco and the Chuska Valley, with the less-abundant trachyte being the most common instance at Pueblo Alto. This permits two interpretations: (1) all vessels with this temper complex came from Chaco, and (2) both areas produced sherd-tempered vessels from which trace quantities of trachyte were introduced. Sherd tempering is clearly more common at Chaco sites and, thus, may suggest that those vessels are local to Chaco; however, sherds containing trachyte would have been more abundant in the Chuska area, and any use of sherd tempering there would stand a good chance of including trachyte in that way. Windes (1977:310-325) reports substantial quantities of trachyte in the sherd temper in the Chuska mineral-on-white series in particular, where sherd temper occurs in higher percentages than in the carbon series. Trachyte is present in all of the Cibola types reported from the CGP survey (Windes 1977:342-346), ranging from 6 percent (Chaco Black-on-white) to 37 percent (Gallup).

Because temper mixtures do occur and because of the large-scale movement of ceramics, the sizable mixed temper category thus remains questionable as to area of manufacture; the best guess now is that these are most likely to be from Chaco. The refiring tests of the sandstone-dominating trachyte group at 29SJ 1360 was a tight buff group with no reds; at Pueblo Alto the small refiring sample from this group is considerably more variable. It contains 25 percent clays that oxidize redder than is common for Chaco, whereas percentages are higher in the Chuska Valley examples (Windes 1977; see refiring section below). The relative occurrences of trachyte temper in the CGP and Chaco samples and of red and reddish-yellow oxidation colors are reminiscent of one another. They both support the contention that the source determination of such sherds is complex, with each area having its "preferences" but with real overlap.

A third major variation in temper is the relative quantities of sherd and sand/sandstone temper. Cibola ceramics are often characterized as having sherd temper; but it is our experience that in most cases other materials, most often quartz grains, are visible in addition to sherd tempering. This, of course, again raises the question of how the other materials got there--naturally, as part of the clay deposit? accidently, as part of the preparation? incidentally, through the use of sandstone-tempered sherds? intentionally, as temper? As we have treated source identifications of most sandstones as beyond our capabilities, the problem is less significant than the trachyte question. Nonetheless, trends can be seen in the use of sherd temper in the estimates of sherd quantity. The proportions of vessels with more sherd than sandstone to those with more sandstone than sherd are greatest in the Puerco-Escavada-Gallup lump at about 3:1, with the Puerco and Escavada subsets at around 4:1. In the earlier Red Mesa group the proportion is 2:1, and in the carbon-on-white groups the proportions are about equal. In Red Mesa, Escavada, and Puerco the combined sherd and sherd and sandstone categories comprise over 80 percent of each group's temper; the occurrence in Gallup and the carbon

types is considerably less, owing mostly to the increased frequencies of trachyte in some combination in the latter.

The overall use of sherd temper (regardless of other elements) is different for the six types (Table MF-1.17). Each group displays the full range of no-sherd to all-sherd temper, but there are differences in proportions. There is more Escavada than statistically expected in both the all- and no-sherd temper classes. This suggests that, though nearly all members of this group fall into the indistinct temper type "sandstone," there are, nonetheless, different producers represented within the group. Escavada is also low in the less-than-half sherd temper category, showing an overall tendency in this group to relatively greater use of sherd temper.

The other types deviating from the expected are less erratic than Escavada. Use of sherd temper in Chaco McElmo was made in most cases, but the estimated amount is less than half in the majority. As Chaco McElmo is generally sparsely tempered with fine materials, these estimates were often difficult to make, but the coding does reflect the paucity of temper and the fineness of the paste. The PII-III Carbon group, on the other hand, has more than the expected number of items lacking sherd temper, which leads to a significant difference in the two carbon types' use of sherd temper; the proportions of more-than-half sherd temper are similar in the two groups. The mineral-painted types, however, show no significant differences in this attribute, either between time segments (Red Mesa versus Puerco-Escavada-Gallup) or within (Puerco and Escavada, the two most different in percentage terms do not differ significantly--Table MF-1.17).

The occurrence of different sand-grain sizes also varies among types showing the largest coefficient of contingency in this series of paste tests. Chaco McElmo is again a distinctive group, here because of the predominance (77 percent) of fine-grained sands. Escavada from Pueblo Alto is the opposite, showing a majority of sand grains in the coarse to very coarse range. While the other mineral-painted types show from 5-21 percent coarse to very coarse, Escavada shows 57 percent. The 5 percent in Red Mesa is low at Pueblo Alto compared to 29SJ 627 where the figure is 15 percent; still there does seem to be some trend toward higher prcentages of coarse sands from Red Mesa to Puerco-Escavada-Gallup.

Temper diversity indices for mineral-on-white types have the same between-type relationships as those found at 29SJ 627--Red Mesa is the least diverse and Gallup the most (Table MF-1.20). Escavada, which was not analyzed in detail at 29SJ 627, is even less diverse than Red Mesa. It is notable that when temper classes are relumped to be equivalent to those in effect for the 29SJ 627 analysis, the diversity indices for Pueblo Alto Red Mesa, Puerco, Gallup, and "Puesga" are all higher than those indices for the same types at 29SJ 627.

A texture index has been calculated by multiplying the ordinal grain size estimate for the primary geological temper by the density estimate code and then dividing by the relative quantity of sherd temper [grain

size (values of 1, 3, 5, 6) x temper density (1-5) divided by relative amount of sherd temper (0, 1, 2, 3) + 1]. Although the result is subject to a number of drawbacks, including multiplication of ordinal codes and possible underestimation of the effects of heavy sherd temper on paste coarseness, it does give a single ordinal ranking of paste texture. The diversity of texture indices for the same types and of sand grain sizes (both of which are comparable for the two sites' systems) show that 29SJ 627 is in all cases more diverse than Pueblo Alto except in Red Mesa texture where the two sites are about the same. Trends at the two sites are also different. At 29SJ 627 texture diversity increases from Red Mesa to Gallup or to "Puesga;" at Pueblo Alto texture diversity decreases from Red Mesa to Gallup, though Red Mesa and Puerco are about the same. Sand-grain size at both sites shows a tendency to increase slightly. The diversity and evenness of temper in both carbon-on-white types at Pueblo Alto is relatively high.

Over half of all the whiteware types from Pueblo Alto fall into the very fine-fine categories generated by the texture index; Red Mesa and Gallup are over 70 percent very fine-fine and Chaco McElmo is 87 percent. Texture among the primary, mineral-painted types differs significantly, but the significant part of the difference is due to the coarse contribution of Escavada and its concomitant low frequencies of fine textures. This can be seen in a test excluding Escavada, which shows no significant difference among the remaining types. In spite of the large Gallup sample, fewer texture index ranges were generated for Gallup (it lacks "very coarse"), and Gallup, thus, shows the lowest diversity of textures among the mineral wares (Table MF-1.20). As has been indicated, Chaco McElmo shows the least diversity of texture of all Pueblo Alto primary types, with texture indices heavily concentrated in the fine end of the range because of low densities and small grain sizes. The catchall nature of the PII-III carbon group may again be seen in the high diversity of the texture index.

Visually determined, clay groups are not significantly different among types, and the diversity of the types is steady. Chaco McElmo shows the lowest diversity, which seems to fit with its behavior in paste attributes other than temper. Vitrification estimates, however, do show a difference that results from deviations from the expected in Gallup, PII-III carbon, and Chaco McElmo. Relatively larger quantities of Gallup are markedly vitrified, and relatively more Chaco McElmo appears to lack vitrification. The PII-III carbon group makes the largest, single, Chi-square contribution because of the low occurrence in the marked vitrification category. Inspection of the mineral-painted groups shows that vitrification incidence is fairly uniform among them--most of the difference found above is in the lower vitrification of the carbon-painted groups. Although the vitrification attribute is a problematic one governed by many uncontrolled variables, this incidence suggests that lower firing may have been a necessity with the use of carbon paint.

Grayware Surfaces and Pastes
(Tables MF-1.21 to MF-1.24)

Only two, closely related, grayware classes were sufficiently numerous to be treated in detail. The use of types for graywares is notably underdeveloped in Chaco (see also Franklin 1982; Marshall et al. 1979) as compared to either whitewares or to the graywares in, for example, the Mesa Verde area (Breternitz et al. 1974; Lucius and Wilson 1981). The classification in use here for graywares is based mainly on surface treatments and rim eversion. The vast majority of bulk count graywares from Pueblo Alto are indented corrugated, in keeping with the site's post A.D. 1000 date (Table MF-1.4). The two groups discussed in detail go by the poetic names PII corrugated and PII-III corrugated. They are defined primarily as having overall indented corrugation and more-or-less straight (PII) to somewhat everted (PII-III) rims. Secondary considerations, less consistently employed than location of corrugation and rim eversion, were that finer texture and surface manipulation were thought to be associated with later vessels. As will be seen below, these considerations seem to have had little influence on type placement.

Using categories such as these, which have some temporal value but which are not subject to as many classification problems as full-blown types, allows examination of temporal variation in a site's grayware without further biasing from type assignments. Nothing is lost with respect to source information because a primary determinant of gray types is their temper, and other attributes relevant to type assignments are included. The advantage to this system, then, is that covariation of attributes may be examined more fully, with less risk of implied associations forced by typing. In many ways this is preferable to the situation in the whitewares. There is little doubt that, as with any stylistic temporal assignment, there is overlap between the two groups, especially as the variation in rim flare is continuous. Still, the discreteness of the deposits that make up most of this sample lends considerable support to the temporal value claimed for the groups:

Proveniences	A.D. 1020-1120	A.D. 1120-1220
% of PII corrugated sample	84	5
% of PII-III corrugated sample	31	63
% of total sample	68	15

The A.D. 1020-1120 proveniences include much of the Trash Mound, all of the Kiva 13 sherds, and parts of Rooms 103 and 110. The majority of the ceramics from A.D. 1120-1220 proveniences come from Kiva 10 fill, with some from Kiva 16 and Room 103 as well. PII-III corrugated sherds were not found in proveniences dated before A.D. 1020-1120, nor in the A.D. 1020-1040 time group, but PII corrugated sherds were present in both.

In most respects the two groups are quite alike. Comparisons of types of corrugations show that the two groups have similar distributions of the common surface treatments. Neckbanding is slightly more common in

the PII group, probably because of its earlier manufacture. The PII group also contains higher percentages of items displaying narrow fillets than the PII-III group but not enough to make a significant difference (Tables MF-1.21, MF-1.23, and MF-1.25).

Grayware sherds are amenable to several measurements that may be used to search for groupings and trends. Those used most extensively here are orifice diameter (also measured for vessels of other wares, always subject to sufficient sherd size), rim fillet width, and rim flare (see Figure 1.7). Within limits, orifice diameter relates to vessel size (see McKenna and Toll 1984:196; Toll 1985:256). Both PII and PII-III corrugated from Pueblo Alto show a wide range of jar estimated diameters with means around 21.5 cm, modes of 19-20.5 cm, and similar frequency curves (Figure 1.8). Identifiable gray pitchers are very rare--only one PII example was noted.

Although the frequency curve of PII-III is quite smooth, the PII curve shows a second, lower peak at 25-26.5 cm; the group is large enough that this distribution may indicate some functional difference, but the diameter is probably too large to indicate a pitcher group. Rim fillet width means and distributions are also very close with a marked peak at the 20-22-mm width in both groups, though the PII-III range is broader and coefficient of variation higher (Figure 1.9). The importance of rim flare to classification is clearly visible in the higher mean flare of the PII-III group. However, even this dimension shows considerable overlap between the groups in the 22-36° range (Figure 1.10). This overlap is not surprising, as PII-III corrugated is an intermediate classification and on occasion was used as a default group for rims of questionable eversion but appropriate texture and surface manipulation.

As at 29SJ 627, there seems to be a decline in the frequency of handles relative to examples. The ratio in PII corrugated at 29SJ 627 is 1:23, at Pueblo Alto it is 1:33, with around 1:10 in the 29SJ 627 neck-banded groups. The Pueblo Alto PII-III group contains only two handles, giving a ratio of 1:58. Once again, the "tit lug" is the most common form.

The pastes of the Pueblo Alto groups also differ in only minor ways. The overall presence of trachyte (trachyte and trachyte-plus-sandstone combined) in the PII-III group is over 60 percent and around 54 percent in PII; the PII group, on the other hand, contains more chalcedonic cement sandstone temper. These discrepancies are too small to give a Chi-square value significant at .05 (Table MF-1.17). As clay and texture distributions are also statistically similar, the only attribute suggesting some difference in supply area is sand-grain size, which is significantly different. The PII-III group contains a greater-than-expected quantity of fine- and medium-grained sands, which may have to do with its greater relative frequency of sherd temper, though this difference is also slight. Alternatively and/or concomitantly, some other shift in supply area may be the cause of this difference; perhaps some replacement for the chalcedonic sandstone group was necessary. In spite of the differences in sand-grain size, no difference is found in the texture index.

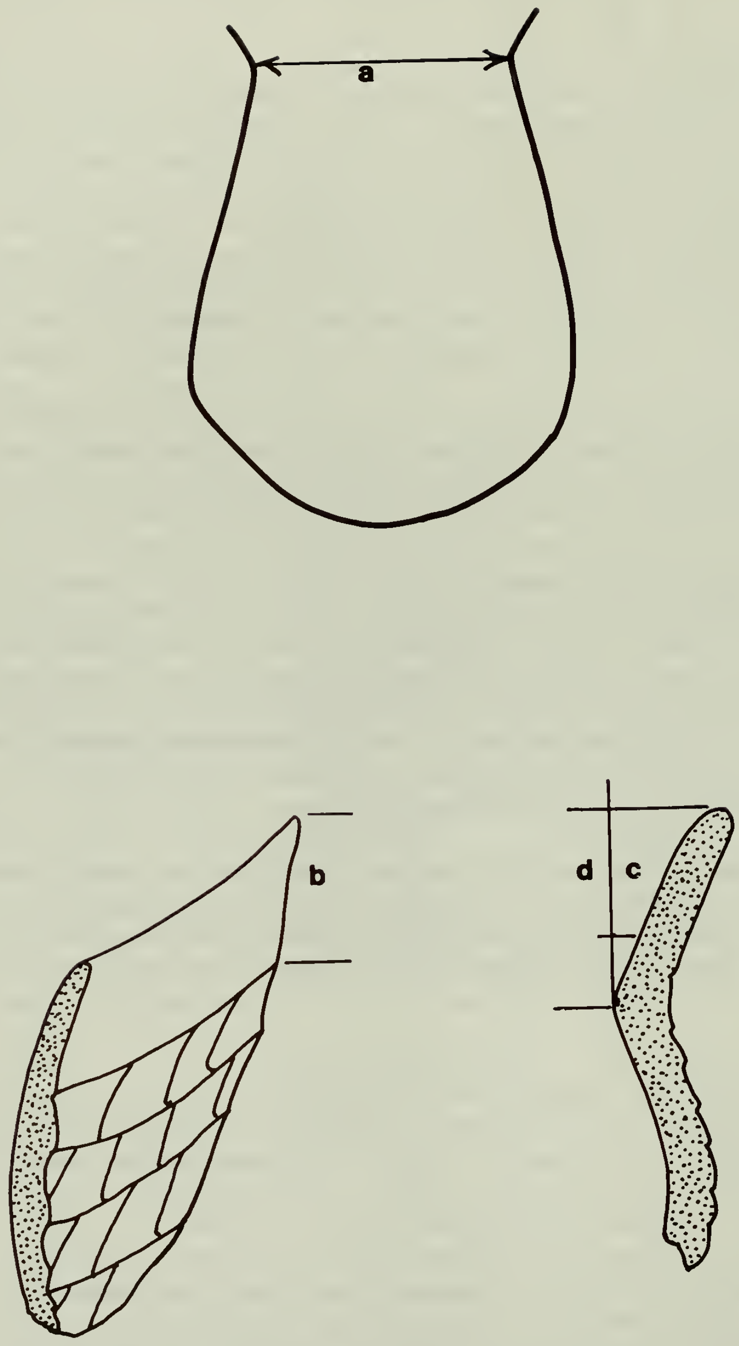

Figure 1.7. Metric variables used in grayware studies. A) Orifice diameter shown in cross-section of whole vessel (usually estimated from sufficiently large sherds). B) Rim fillet width. C) Rim flare angle. D) Orifice-to-rim distance.

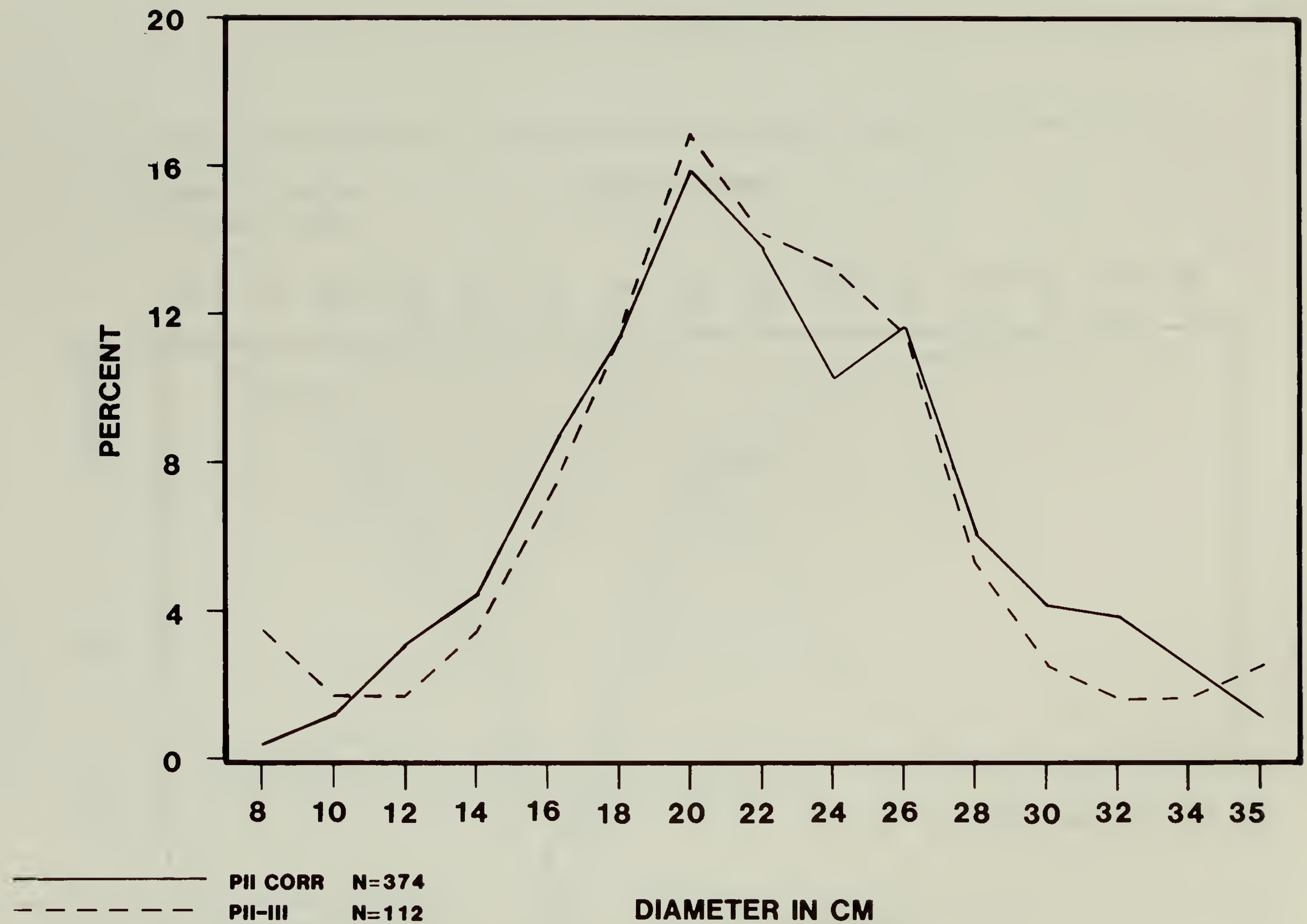

Figure 1.8. Frequency distribution of grayware jar diameters in primary types.

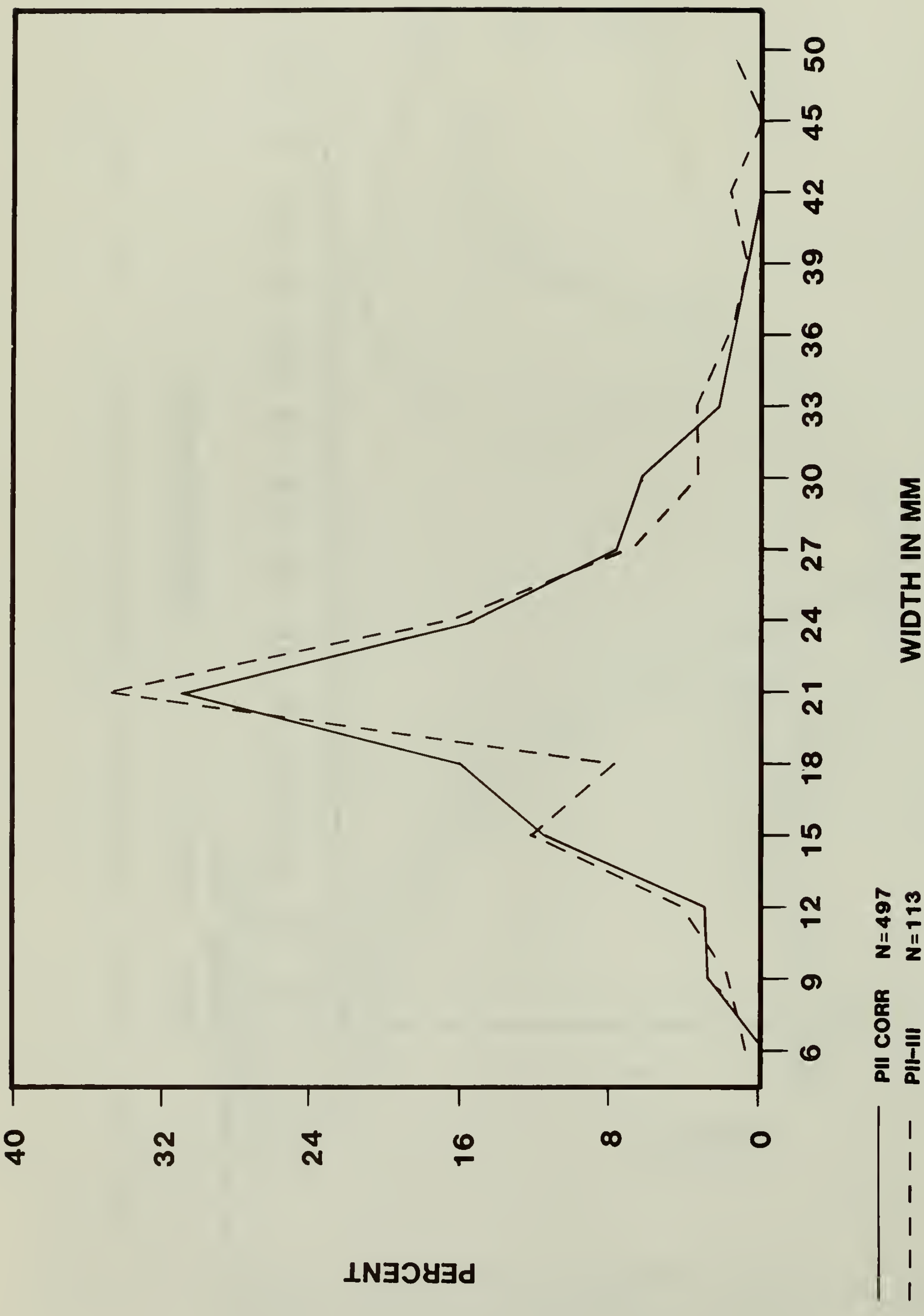

Figure 1.9. Frequency distribution of grayware jar rim fillet widths in primary types.

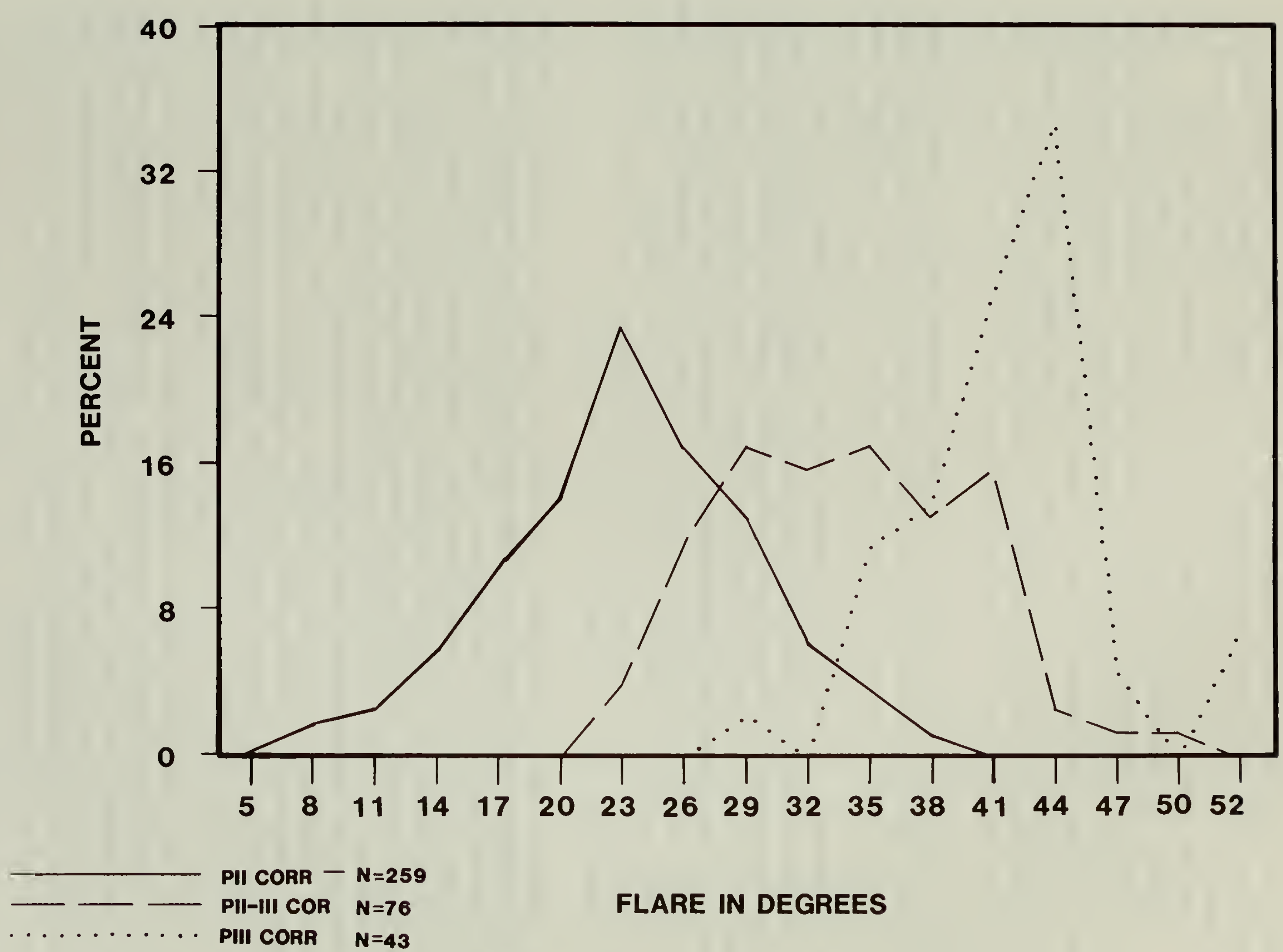

Figure 1.10. Frequency distribution of grayware jar rim flare in primary types and Pueblo III corrugated.

The largest single category in any of the variants on the sample from Pueblo Alto is "unidentified corrugated" (Table 1.4). PII corrugated is 60 percent of the identified corrugated types and PII-III 26 percent; it is, therefore, likely that the unidentified group is largely from vessels of these two types. The temper composition of the unidentified group is in fact nearly identical to that of the PII group (Table 1.6). The slightly higher percentage of trachyte in PII-III corrugated is reflected in the unidentified group's trachyte content; the depressed quantity of trachyte in PIII and increased sandstone frequency suggest very little contribution from that group. That 85 percent of the unidentified corrugated in the detailed sample comes from the Trash Mound, which is dominated by PII corrugated, further increases the probability that unidentified corrugated is mostly from PII corrugated jars.

Within the PII group there is a marked association of trachyte temper with the surface treatment of patterned corrugation with narrow bands. The small, chalcedonic group follows the expected, and the sandstone group is the converse of the trachyte (Table MF-1.17). Although a similar suggestion is present in the PII-III group--five of six items with patterned, narrow corrugations have trachyte temper--the sample is too small to test. Wide coils appear to be found more often with sandstone temper and narrow coils with trachyte in both groups; but, again, the difference is not significant. In any case, the occurrence of wide-coil corrugations is very low in both the PII and PII-III groups; narrow-coil corrugation is the most abundant surface treatment in both groups in all tempers. Its lowest relative frequency is 41 percent in PII-III sandstone and is over half of all PII temper groups.

In view of the similarities between the two time groups at Pueblo Alto, the differences found in a comparison of PII corrugated from 29SJ 627 and Pueblo Alto are intriguing. The three main tempers--sandstone, trachyte, and chalcedonic sandstone--are distributed differently at the two sites. Trachyte is found to associate with Pueblo Alto, whereas sandstone associates with 29SJ 627, chalcedonic sandstone being equivalent at the two sites. To go along with this difference in temper, the Pueblo Alto group shows considerably higher percentages of "Chuska gray" clay. Sand-grain distributions test as similar, but surface manipulations are different. The result in the Pueblo Alto group alone would suggest that patterned, narrow corrugated would be the surface treatment difference between the sites because of its trachyte association; however, this surface treatment is nearly equally represented. Instead, there is further support for the suggested sand-temper/wide-coil association since wide coils associate with 29SJ 627, and narrow with Pueblo Alto. Another, larger contributor is that whereas 5.5 percent of the 29SJ 627 PII corrugated has flattened coils, at Pueblo Alto only 1 percent does. This does not seem to be necessarily a temporal phenomenon, as 3.2 percent of the Pueblo Alto PII-III items show coil flattening.

The metric attributes of the two sites' PII groups are quite similar in both size and variability, though the 29SJ 627 examples are considerab-

ly more flared (means of 28.5° as opposed to 22.9°, standard deviations of 6-7). One metric comparison of interest occurs between the Pueblo Alto-PII-group and the 29SJ 627-PII-group where rim flare in the Pueblo Alto sample is about one standard deviation less than the Pueblo Alto-PII-III mean, whereas the 29SJ 627-PII-group is only about half a standard deviation less than the Pueblo Alto-PII-III, mean flare. The explanation for this is clearly to be found in classification practice rather than in cultural significance. In all likelihood a subconscious (?) bias against terming items "PII-III" at 29SJ 627 existed, because of conceptions about that site's age, causing some items that would have been called PII-III at Pueblo Alto to be called PII at 29SJ 627. A test and partial cure for this bias would be to examine all corrugated for rim flare modes, divide the group accordingly, and test the divisions against type assignments, proveniences, tempers, and other attributes. Rim flare is further examined by provenience in the time-space section of this report, where it is shown that rim flare--without regard to type--does seem to be a reliable time indicator.

A final, apparent difference is that the Pueblo Alto PII corrugated shows as generally somewhat finer on the texture index. Part of this difference is in the temper density estimates, which tend to be lower at Pueblo Alto. It may be suspected that this difference is at least, in part, analytical drift, as well, though unquantified trends to finer culinary ware later have been noted in Table 1.15 for Kin Kletso.

Type-Temper-Paint Whiteware Groups

A procedure followed at 29SJ 629, 29SJ 1360, and 29SJ 627 was to isolate groups of vessels that had the same paint and temper from within groups. The groups so formed are thought to be as close as is possible with this analysis to ceramics that could represent fairly limited production groups both in time and space. The results are complicated, showing cross-cutting dissimilarities and similarities of various aspects, with similarities more common than differences, making interpretations ambiguous. Because the procedure is helpful in giving an idea of the variability within types, and to make similar information available from Pueblo Alto, an abbreviated presentation is made here. In the interest of streamlining the presentation, only designs, forms, sherd temper content, and bowl means will be considered.

These data are presented in Tables 1.16 to 1.18. As the setup of the tables encourages comparison of particular groups, especially in the design tables where the percentages of design occurrence within a group are from the table totals, a word on the rationale of the setup is in order. Table 1.16 is perhaps the most suspect grouping because it includes types attributed to two different periods--Red Mesa and Puerco-Escavada. In the conventional wisdom and according to the results in the previous section, however, the types are similar in a number of ways; this table essentially shows a subdivision of predominantly solid-element, mineral-painted ceramics. The previous section also shows Gallup to be fairly distinctive as compared to other mineral types; Gallup is also the most abundant type at

Table 1.15. Refiring colors of trachyte-tempered and non-trachyte-tempered graywares from the final analysis sample (the Trash Mound).

	COLOR GROUP								
	Buff 1	2	3	4	5	6	Red 7	Gray	Total
Grayware									
Plaza Gr. 8 trach.	7	1	8	3	9	1			29
Booth 1 non-tr.	5							1	6
Booth 1 trachyte	2	1	5	1	3				12
Booth 2 non-tr.	1		1					2	4
Booth 2 trachyte					3	2			5
Booth 3 non-tr.	1	1	2						4
Booth 3 trachyte				1	2	3			6
Booth 4 non-tr.	1	2	1		2			1	7
Booth 4 trachyte			1		3				4
Booth 5 non-tr.	2		2	1					5
Booth 5 trachyte					2	3			5
Booth 6 non-tr.	2	1						1	4
Booth 6 trachyte						5	1		6
TM general trach.	3	1						1	5
Kiva 10 L 4 trach.			4		5	1			10
Kiva 10 L2-3 trach.	1		1		11	6			19
Una Vida trachyte[a]	1	8	2		16	17			44
Kin Kletso trachyte[a]	10	10	11	6	11	1			49

[a]From McKenna 1980.

Table 1.16. A. Red Mesa, Escavada, and Puerco temper-paint-grain size group comparisons of vessel form, bowl metrics, and designs, Pueblo Alto.

					COMBINATION							
TYPE:	Red Mesa				Escavada		Puerco					
TEMPER/GRAIN SIZE:	SS		SS		SS		SS		SS/fine		SS/cse.	
PAINT COLOR:	brown		black		black		brown		black		black	
LETTER CODE:	A		B		C		D		E		F	
	n	%	n	%	n	%	n	%	n	%	n	%
FORM												
Bowl	20	69.0	119	82.1	40	75.5	22	45.8	61	66.3	11	52.4
Ladle	4	13.8	9	6.2	6	11.3	4	8.3	9	9.8	3	14.3
Pitcher	1	3.4	2	1.4	1	1.9	2	4.2	1	1.1	1	4.8
Canteen							1	2.1				
Seed jar			1	0.7	1	1.9						
Tecomate									1	1.1		
Olla			1	0.7			5	10.4	3	3.3	1	4.8
General jar	4	13.8	12	8.3	5	9.4	14	29.2	17	18.5	5	23.8
Duck pot			1	0.7								
Totals	29		145		53		48		92		21	
diversity	0.919		0.703		0.832		1.373		1.022		1.248	
evenness	0.663		0.361		0.517		0.766		0.570		0.776	
forms (s)	4		7		5		6		6		5	
MEAN DIAMETERS												
Bowl mean	190.6		194.0		187.4		183.5		192.0		231.0	
Bowl s.d.	61.37		63.62		82.18		56.40		69.83		68.75	
Bowl n	16		93		29		13		38		10	
Ladle mean	110.0		103.3		126.7		115.0		106.2		100.0	
Ladle s.d.			46.19		17.56				20.56			
Ladle n	1		3		3		2		4		1	
Pitcher mean			100.0		70.0		75.0		80.0		50.0	
Pitcher s.d.												
Pitcher n			1		1		2		1		1	

Table 1.16. B. Red Mesa, Escavada, and Puerco temper/paint/grain size group comparisons of designs occurring as 1% or more of the table entry design inventories.

					COMBINATION							
TYPE:	Red Mesa				Escavada		Puerco					
TEMPER/GRAIN SIZE:	SS		SS		SS		SS		SS/fine		SS/cse.	
PAINT COLOR:	brown		black		black		brown		black		black	
LETTER CODE:	A		B		C		D		E		F	
	n	%	n	%	n	%	n	%	n	%	n	%
DESIGN												
Parallel lines	3	7.9	20	52.6	6	15.8	1	2.6	7	18.4	1	2.6
Pendant parallel			2	33.3	1	16.7			3	50.0		
Framers w/tcked sol.	1	14.3	6	85.7								
Corner triangles	1	16.7	3	50.0			1	16.7	1	16.7		
Scrolls	5	15.6	13	40.6	3	9.4	3	9.4	6	18.8	2	6.2
Dotted lines	3	18.8	6	37.5	4	25.0	1	6.2	2	12.5		
Parallelograms					2	33.3	2	33.3	2	33.3		
Checkerboard			7	24.1	7	24.1	2	6.9	11	37.9	2	6.9
Eyed solids			1	14.3	2	28.6	2	28.6	2	28.6		
Sawteeth	1	3.6	9	32.1	4	14.3	5	17.9	6	21.4	3	10.7
Barbs			4	10.8	7	18.9	10	27.0	11	29.7	5	13.5
Elong. scalloped tr.					2	20.0	2	20.0	6	60.0		
Wide line Sosi					5	16.7	13	43.3	7	23.3	5	16.7
Narrow line Sosi	4	15.4	12	46.2	3	11.5	1	3.8	6	23.1		
Heavy curvilinear					4	30.8	4	30.8	4	30.8	1	7.7
Solid band design	11	10.6	49	47.1	10	9.6	11	10.6	18	17.3	5	4.8
General solid	3	8.6	8	22.9	6	17.1	3	8.6	15	42.9		
Hachure A-1	2	11.1	16	88.9								
Squiggle lines	3	30.0	7	70.0								
Ticked triangles	5	10.9	21	45.6	2	4.4	4	8.7	13	28.3	1	2.2
Bowl exterior	1	14.3	1	14.3			5	71.4				
Interlocked ticking	2	14.3	7	50.0			1	7.1	4	28.6		
Other hachure			2	33.3	1	16.7	1	16.7	2	33.3		
Totals	45		194		69		72		126		25	
Total inventory	48		207		74		79		135		27	
% of table inven	8.4		26.3		13.0		13.9		23.7		4.7	

Table 1.17. Pueblo Alto Gallup temper/paint/grain size group comparison based on vessel form, metrics, and design.

COMBINATION																
TEMPER/GRAIN SIZE:	SS/fine		SS/coarse		SS/fine		SS/coarse		SS/Tr.		SS/Tr.		Tr.+SS.		Tr.+SS	
PAINT COLOR:	brown		brown		black		black		brown		black		brown		black	
LETTER CODE:	G		H		I		J		K		L		M		N	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
A. FORM																
Bowl	28	40.6	10	40.0	123	47.9	37	58.7	18	48.6	42	51.2	10	41.7	36	52.9
Ladle			2	8.0	10	3.9	2	3.2	1	2.7	4	4.9	1	4.2	2	2.9
Pitcher	6	8.7			19	7.4			4	10.8	7	8.5	1	4.2	4	5.9
Canteen							1	1.6								
Seed jar	2	2.9			5	2.0					2	2.4	2	8.3		
Tecomate	1	1.4			1	0.4			1	2.7						
Olla	1	1.4			7	2.7	2	3.2	1	2.7					1	1.5
General jar	30	43.5	13	52.0	90	35.0	21	33.3	12	32.4	27	32.9	10	41.7	24	35.3
Duck pot					1	0.4										
Cylinder jar	1	1.4														
Miniature					1	0.4									1	1.5
Totals	69		25		257		63		37		82		24		68	
diversity	1.227		0.909		1.279		0.963		1.249		1.156		1.201		1.099	
evenness	0.631		0.827		0.582		0.599		0.697		0.718		0.746		0.613	
forms (s)	7		3		9		5		6		5		5		6	
B. MEAN DIAMETERS																
Bowl mean	208.9		226.7		215.2		227.6		227.5		196.1		227.9		184.4	
Bowl s.d.	57.52		87.57		60.48		64.70		35.00		66.04		78.52		56.48	
Bowl n	14		9		79		21		12		32		7		16	
Ladle mean			125.0		116.9		100.0				130.0				122.5	
Ladle s.d.					21.87											
Ladle n			1		8		1				1				2	
Pitcher mean	78.8				93.1				100.0		87.5		130.0		85.0	
Pitcher s.d	14.36				32.24				10.00		15.00					
Pitcher n	4				13				3		4		1		1	
C. DESIGN[a]																
Corner triangles	6	16.2	5	13.5	14	37.8	8	21.6	1	2.7	2	5.4			1	2.7
Heavy curvilinear	1	11.1	1	11.1	2	22.2	5	55.6								
Hatched band desn	1	4.4	2	8.7	9	39.1	5	21.7	3	13.0	2	8.7	1	4.4		
General solid	4	20.0			7	35.0	3	15.0			3	15.0	1	5.0	2	10.0
Hachure A-3	3	21.4	1	7.1	5	35.7	1	7.1			2	14.3			2	14.3
Hachure B/C	4	6.9			5	8.6	1	1.7	11	19.0	9	15.5	11	19.0	17	29.3
Hachure B-1	17	14.9	5	4.4	47	41.2	20	17.5	6	5.3	12	10.5			7	6.1
Hachure B-3	4	5.8	8	11.6	34	49.3	9	13.0	4	5.8	6	8.7	2	2.9	2	2.9
Hachure B-4	28	13.6	5	2.4	99	48.1	13	6.3	8	3.9	28	13.6	3	1.5	22	10.7
Hachure B-6	5	8.8	2	3.5	26	45.6	9	15.8	2	3.5	8	14.0	4	7.0	1	1.8
Hachure C	1	5.3			6	31.6	1	5.3	1	5.3	6	31.6	2	10.5	2	10.5
Counterchange			1	9.1	7	63.6	3	27.3								
Hatched checkerbd	2	8.0			13	52.0	1	4.0	2	8.0	1	4.0	1	4.0	5	20.0
Heavy squig. htch	3	15.8			2	10.5			2	10.5	4	21.0	2	10.5	6	31.6
Hatched pendants			1	10.0	4	40.0	3	30.0			2	20.0				
Ticked triangle	2	18.8			6	54.6					3	27.3				
Stepped solid	1	12.5			4	50.0					2	25.0	1	12.5		
Other hachure	4	9.1	3	6.8	19	43.2	4	9.1	2	4.6	7	15.9			5	11.4
Totals	86		34		309		89		42		97		28		72	
Total inventory	93		37		337		97		43		105		29		75	
% of total	11.4		4.5		41.3		11.9		5.3		12.9		3.6		9.2	

[a]Percents shown are of design occurrence. Only designs which constitute 1% or more of

Table 1.18. Pueblo Alto carbon temper/paint group comparisons based on vessel form, metrics and sherd temper content.[a]

	COMBINATION							
TYPE:	PII-III Carbon				Chaco McElmo			
TEMPER/GRAIN SIZE:	SS/all		Trach-SS mix[b]		SS/all black		Trach-SS mix[c]	
GROUP:	O		P		Q		R	
	n	%	n	%	n	%	n	%
A. FORM								
Bowl	38	82.6	20	71.4	17	58.6	28	73.7
Ladle	3	6.5					2	5.3
Pitcher			2	7.1	7	24.1	6	15.8
Canteen					1	3.4		
Seed jar								
Tecomate								
Olla	2	4.4	2	7.1	2	6.9		
General jar	3	6.5	3	10.7	2	6.9	2	5.3
Duck pot								
Cylinder jar								
Miniature			1	3.6				
Totals	46		28		29		38	
diversity	0.650		0.976		1.141		0.826	
evenness	0.469		0.606		0.709		0.594	
forms (s)	4		5		5		4	
B. MEAN DIAMETERS								
Bowl mean	198.8		197.9		201.7		201.5	
Bowl s.d.	57.34		69.42		45.69		60.52	
Bowl n	33		17		12		23	
Ladle mean	65.0						70.0	
Ladle s.d.								
Ladle n	2						1	
Pitcher mean			40.0				71.2	
Pitcher s.d							8.54	
Pitcher n			1				4	

[a]All types in these groups are coded with carbon paint.
[b]Includes 17 trachyte > sandstone and 11 trachyte < sandstone.
[c]Includes 19.

Table 1.18. (concluded)[a]

	COMBINATION							
TYPE:	PII-III Carbon				Chaco McElmo			
TEMPER/GRAIN SIZE:	SS/all		Trach-SS mix		SS/all black		Trach-SS mix	
LETTER CODE:	O		P		Q		R	
	n	%	n	%	n	%	n	%
C. DESIGN								
Parallel lines	8	29.6	4	14.8	6	22.2	9	33.3
Banded framers	1	25.0	1	25.0	1	25.0	1	25.0
Pendant parallel lns	3	60.0	1	20.0			1	20.0
Scrolls	1	14.3	1	14.3	1	14.3	4	57.1
Dots			1	33.3			2	66.7
Linear dots			1	50.0			1	50.0
Dotted checkerboard	1	16.7			5	83.3		
Checkerboard	1	33.3			1	33.3	1	33.3
Eyed solid	1	50.0			1	50.0		
Sawteeth	3	75.0	1	25.0				
Barbs	2	12.5	1	6.2	7	43.8	6	37.5
Wide line Sosi	7	25.0	3	10.7	9	32.1	9	32.1
Narrow line Sosi	5	41.7	1	8.3	3	25.0	3	25.0
Heavy curvilinear	3	60.0	1	20.0			1	20.0
Solid band design	6	42.9	3	21.4	2	14.3	3	21.4
General solid	9	40.9	7	31.8	2	9.1	4	18.2
Hachure A-3	1	50.0	1	50.0				
Interlocked frets					1	25.0	3	75.0
Jar neck motif	2	66.7			1	33.3		
Other hachure			2					
Totals	53		29		40		48	
Total inventory	57		33		42		50	
% of inventory	31.3		18.1		23.1		27.5	

[a]Percents shown are of design occurrence. Only designs constituting 1% or more of aggregate inventory included.

Table 1.19. Within-type breakdown by temper and paint or surface manipulation, Pueblo Alto.[a]

A. Number of groups and sherds per group

Type	n	n of Attribute groups	Mean n of sherds per group	s.d.	Range of items per group	Group Makeup Members per group 1	2-10	11-20	21-39	>40
Red Mesa Black-on-white	223	16	13.94	35.877	1-146	5	9	0	1	1
Escavada Black-on-white	88	13	6.77	14.720	1-53	6	5	1	0	1
Puerco Black-on-white	210	21	10.00	25.786	1-113	10	7	1	0	2
Gallup Black-on-white	733	30	24.43	61.120	1-321	5	16	3	2	4
PII-III Carbon/ white + temper[b]	94	10	9.40	13.842	1-46	1	6	2	0	1
Chaco McElmo Black-on-white[b]	74	7	10.57	11.516	1-29	2	2	2	1	0
Pueblo II Corrugated[c]	204	25	8.16	16.982	1-64	10	11	2	0	2
Pueblo II-III Corrugated[c]	86	17	5.06	8.400	1-34	7	8	1	1	0

B. Within-type diversity of attribute groups.

	Diversity	Evenness	Number of groups accounting for 25%	50%	75%	90%
Red Mesa	1.383	0.499	1	1	2	6
Escavada	1.372	0.535	1	1	2	6
Puerco	1.587	0.521	1	1	2	6
Gallup	2.040	0.600	1	2	4	9
[PII-III Carbon/white[b]	1.614	0.701	1	2	3	5
[Chaco McElmo[b]	1.409	0.724	1	2	3	3
Pueblo II corrugated	2.109	0.655	1	2	4	11
Pueblo II-III corrugated	2.070	0.731	1	2	5	10

[a]Excludes unobservable temper, includes unidentified igneous. Note that this table does not take into account subdivision of large groups by sandstone grain size.
[b]Carbon paint only, by definition--potential number of groups reduced.
[c]Excludes undifferentiated banded, undifferentiated corrugated, and rim fillet only.

Pueblo Alto and, therefore, forms the most numerous, workable subgroups (Tables 1.17 and 1.19). The third set of tables has in common both time group (late) and paint type (carbon), as well as similarities in temper and design noted previously (Table 1.18). Comparisons are, of course, valid outside the tables, but the main point of interest in the exercise is subtype variation.

The carbon paint groups were formed under different circumstances from the mineral groups. First, no variants of carbon paint were recorded, so that fewer possibilities for subgrouping existed. Second, both type groups are relatively small in this collection. Each type contains substantial quantities of trachyte, but the trachyte occurrence is split quite evenly between more trachyte than sandstone and more sandstone than trachyte (Tables MF-1.4 and MF-1.14), so that subgroups would be quite small (all less than 20) were this distinction maintained. The distributions of forms and designs in the Chaco McElmo trachyte-sandstone subgroups are very similar and a t-test of bowl diameters shows no significant difference, so these subgroups were lumped to form Group R. There is more between-group variability in the two PII-III Carbon-on-white subgroups--the relative frequency of bowls is higher in the trachyte-greater-than-sandstone group; the trachyte-less-than-sandstone contains more Sosi designs and lacks band designs; the trachyte-greater-than-sandstone group has little Sosi and more frequent band design. However, a Fisher's test shows the difference in forms to be not significant, and a t-test shows the bowl diameters also to be similar. Therefore, with some reservations, these were also lumped here to form Group P.

The Pueblo Alto results are similar to those at other sites. Differences are present within types but never do the differences occur in all attributes. For example, although coarse sandstone, brown-painted, Gallup bowls have a larger mean diameter than the fine sandstone, brown-painted group, the percentages of bowls are the same. In Gallup the brown-painted groups tend to have larger mean bowl diameters, whereas in Puerco and Red Mesa, the black-painted groups do. Coarse-sandstone bowl means are larger than their fine type-paint counterparts in three of three pairs. Differences clearly exist between groups from different types, but many such differences are visible at the type comparison level.

The problem is, thus, one of (1) deciding where to look for consistencies--should each subgroup be different if each, in fact, represents a production area? (2) interpreting consistencies--if all brown-painted groups share some attributes, does it signify a firing problem engendered by that attribute (e.g., vessel size) or is it an areal indicator? (3) interpreting broad similarities--if groups are similar on most attributes, do they represent variations from a single production area or can they be interpreted as multiple areas conforming to a strong regional ceramic tradition with well-defined ceramic needs? Of course, the variables going into the formation of the groups can be weighted as to their source information value. Thus, consistency between trachyte-tempered groups is more likely to have source significance than is one between brown mineral-paint groups, which seems more likely to be a technological difference. The

source information contained in the type assignment is too general for the present discussion, as can be seen by the presence of numerous tempers within types.

The "solid element mineral" groups (Table 1.16) contain only sandstone-tempered items (it will be recalled that these types contain low percentages of other tempers, including trachyte). Further, only the Puerco black-paint group was large enough to subdivide by grain size. Several typological trends are again apparent--high percentages of bowls in Red Mesa with increased closed forms (and hence diversity) in Puerco, with Escavada intermediate. In this sample there is a general similarity in mean-bowl-diameter estimates, with the much-larger-mean but small-count exception of the coarse sandstone, black-paint Puerco group (F). Perhaps the only notable trend within groups is to higher jar percentages in the brown-paint groups (A and D) and, again, group F. The frequency of closed forms in Group D contributes substantially to the rare, intratype-significant Chi-square for form comparisons (Table MF-1.25).

Gallup Groups G and H also show some tendency toward sandstone temper and brown paint having higher percentages of jars, especially the coarse-grained Group H. Within the context of all the Gallup groups having higher jar frequencies than any of the solid element groups, whether mineral or carbon paint, these groups stand out for jar content. Ladles are remarkably infrequent and are absent from some groups; pitchers are absent from both coarse sandstone groups (H, J). However, these differences do not yield a significant Chi-square when all groups are tested on bowl versus closed forms or when the five largest groups are tested by bowl, pitcher, closed, and jar forms. Note that ladles have been excluded from the tests throughout and that the test of the larger groups excludes the brown-paint, coarse-sandstone Group H with its absence of pitchers and high jar percentage (Table MF-1.25).

It is noteworthy but somewhat inexplicable that all the type-temper-paint Gallup groups have lower percentages of bowls and higher percentages of jars than does the overall Gallup sample (Table MF-1.9); the percentages from the sum of the groups are closer, but still low. The groups account for 60 percent of the total detailed sample of Gallup and 85 percent of the Gallup in the temper sample. This discrepancy is likely to result from one of two things--either a heavily bowl-oriented group exists and was not isolated by this method, or the Trash Mound test trench contains an inordinate number of Gallup bowls. The two black-painted, trachyte-sandstone-mix groups (L, N) have substantially smaller mean-bowl-diameter estimates than the rest of the Gallup groups. The carbon subgroups (Table 1.18) show great similarity both within and across types except for the very high percentage of pitchers in Chaco McElmo, which reach their highest level at 24 percent in the sandstone-tempered Group Q.

Designs within groups are mostly rather infrequent and not amenable to extensive testing. Some idea of possible anomalies may be gained by comparing the percentage of each design given (calculated as the portion of a particular design found in a group within each table) with the per-

centage each group's designs form of the whole design inventory of the particular table. Black and brown Red Mesa groups (A, B) show no difference either on the more abundant designs or by inspection, nor do the Escavada and Puerco groups (C-F--Tables 1.16 and MF-1.25).

The designs in the Gallup groups are considerably more interesting. Here, a decided association of squiggle hachure with trachyte groups can be seen--both hachure B/C (see Figure 1.5) and heavy squiggle hachure are such designs, the difference being in spacing and width of the lines. Although both design types are present in the sandstone groups, B/C, in particular, is a "trachyte design," a fact reflected in the Chi-square tests (Tables 1.17 and MF-1.25). This same association is present in the 29SJ 627 ceramics (Toll and McKenna 1981:55-56), which gives it additional credibility. Note that these squiggle hatch designs are high in relative frequency in both the groups estimated to contain more sandstone than trachyte <u>and</u> those in which trachyte is the dominant nonsherd temper; there is a slightly greater emphasis on squiggles in the dominantly trachyte groups. If it represents an areal decoration preference rather than a temporal one, this design occurrence fits with (1) the idea that use of more trachyte than sandstone is more likely to be Chuskan in origin, and (2) the idea that some of the sandstone-greater-than-trachyte group also represents items from the trachyte-tempering area.

Of the other hachures, C also has a trachyte tendency (as might be expected from the B/C association), and B-3 (more spaced hachure in heavy-line framers) occurs disproportionally in the sandstone groups. Hachures B-1, B-4, and B-6 all are proportional to the various groups' overall occurrences. Heavy curvilinear lines occur only in the sandstone groups, being concentrated in the coarse-grain, black-paint Group 3; corner triangles also tend to be found on sandstone-tempered sherds. Because filling corners to create the latter element is thought to be an early Gallup decoration, it may be that within Gallup more early specimens were made in the sandstone area (locally?) and more later items in the trachyte area, in keeping with other trends of trachyte increase in Chaco. Even if squiggle hatch and corner triangles were differentially used through time, these results show that there is a space association as well.

The use of sherd temper in the whiteware groups was also compared (Tables MF-1.20, MF-1.26). Though the mineral-painted, sandstone tempered groups (A through J) show differences in amounts of sherd temper, none appears to be statistically significant. There tends to be somewhat less sherd temper in brown mineral paint items and in coarse sandstone-tempered items, but, again, the differences are slight. As consistently observed elsewhere, the trachyte-tempered classes (Groups K through N) use less sherd temper than do the sandstone-tempered classes. Within the trachyte-tempered group, the cases with more trachyte than sandstone in mixed tempers have significantly less sherd temper than do the groups with more sandstone than trachyte. This difference corroborates the contention that vessels containing mixtures of trachyte, sandstone, and sherd temper probably come from a number of sources, some probably in the Chuska area. The significant difference between sandstone temper and trachyte temper in association with sherd temper is again visible in the PII-PIII Carbon-on-

white groups (O and P), in which the trachyte cases contain much less sherd temper. Sherd temper use in the Chaco McElmo groups (Q and R), is statistically similar.

Grayware Groups

Because of the larger number of surface treatments recorded for graywares, group creation causes a finer subdivision, meaning smaller grayware groups (Table 1.19). The three groups large enough to manipulate all have narrow coil corrugation. Two--one PII and one PII-III corrugated--groups have trachyte temper (T, U) and the third, a PII group, has sandstone temper (Table 1.20).

As in the whiteware groups, there are similarities among the groups, but there are more divergences, especially between the trachyte-tempered Groups T and U and the sandstone-tempered Group S. The presence of sooting in each group is 55-60 percent, again showing that, though trachyte may have better resistance to thermal shock than quartz (Rye 1976; Toll 1984), there is no evidence for preferential use of trachyte vessels for cooking. The texture index for Group S shows 29 percent of cases with finer than medium texture. Although Group S has 94 percent coarse to very coarse grain size, it has lower temper densities (44 percent estimated at 10 percent temper or more) and greater frequency of sherd tempering (present in 13 percent), both of which serve to lower the texture index. More than 80 percent of both the trachyte groups have temper density estimates of 10 percent or greater, and both show a virtual absence of sherd temper (present in one sherd in Group T--2 percent). There is a reversal in texture percentages between trachyte groups T and U--62 percent of T is coarse to very coarse on the texture index whereas only 30 percent of U is; the primary difference is that although 76 percent of T has coarse- or very coarse-grained temper, only 44 percent of U does. This is another of a series of somewhat disjointed suggestions that culinary texture becomes finer through time (e.g., see grayware type descriptions herein and in McKenna and Toll 1984).

The predominant clay color in the sandstone group is black (52 percent) followed by tan (21 percent). One PII-III trachyte-tempered sherd was the only item from Groups T and U with black paste. Both the trachyte groups are dominated by Chuska gray clay, but the PII-III group (U) shows considerably more tan clay than the PII group (33 percent versus 16 percent). Less than 10 percent of the trachyte groups shows an apparent lack of vitrification, but 16 percent of the sandstone-tempered group seems to be lower fired. Although 7 percent (1:11) of the sandstone-tempered group has handles, the trachyte groups show none; a similar absence of handles in the trachyte PII corrugated was found at 627 (Toll and McKenna 1982: Table 1-21).

The measurable attributes of the graywares (Figure 1.7) also show overall similarities with definable differences at a lower level. The distributions of orifice diameter and especially rim fillet width (Figure

Table 1.20. Type-temper-paint or surface treatment groups, Pueblo Alto; percentages given are of the entire temper sample for each type.

Computer Letter Code	Type	Temper	Paint	Grain	n
	RED MESA				
A		Sandstone	brown	all	29
B			black	all	146
Total					175
% of total Red Mesa					78.5
C	ESCAVADA	Sandstone	black	all	53
% of total Escavada					60.2
	PUERCO	Sandstone			
D			brown	all	48
E			black	fine	92
F				coarse	21
Total					161
% of total Puerco					76.3
	GALLUP				
G		Sandstone	brown	fine	69
H				coarse	25
I			black	fine	257
J				coarse	64
K		SS>Trachyte	brown	all	37
L			black	all	82
M		Trachyte>SS	brown	all	24
N			black	all	68
Total					626
% of total Gallup					85.3
	PII-III CARBON-ON-WHITE				
O		Sandstone	carbon	all	46
P		Trach-SS mixes	carbon	all	28
Total					74
% of total PII-PIII Carbon					78.7
	CHACO McELMO				
Q		Sandstone	carbon	all	29
R		Trach-SS mixes	carbon	all	38
Total					67
% of total Chaco McElmo					88.2
	GRAYWARES PII CORRUGATED				
S		Sandstone	narrow corr.	all	62
T		Trachyte	narrow corr.	all	64
Total					126
% of total PII Corrugated					54.8
	PII-III CORRUGATED				
U		Trachyte	narrow corr.	all	34
% of total PII-PIII Corrugated					34.7

1.9) conform to the same basic pattern (Table 1.21, Figures 1.11 and 1.12). The diameter plot is more erratic than might be expected with groups as large as S and T. Each group shows multiple peaks:

S PII corrugated, sandstone temper at 16 and 22 cm;

T PII corrugated, trachyte temper at 18, 22, and 26 cm; and

U PII-III corrugated, trachyte temper at 18, 22, and 28 cm.

Marked low frequencies are present in T at 24 cm and U at 26. Such a distribution suggests well-defined functional categories; distributions at 29SJ 627 are much closer to the normal curve, though the analogous PII narrow-coil, trachyte-tempered group also peaks at 22 and 26 cm. All of the PII groups at both sites, in fact, have their highest peaks at 22 cm. Of the three Pueblo Alto groups, the PII-III group (U) has the largest mean and the largest standard deviation of rim diameters.

Group T has the smallest standard deviation for both diameter and rim fillet, which is consistent with results from 29SJ 627 and can be seen as an argument for localized production (Toll 1981, 1983). The other trachyte group also has a small coefficient of variation for rim fillet width, and both trachyte groups are less variable than the sandstone group in rim flare and fillet. The PII-III group has markedly more rim flare than the PII groups as per the type definition (Table 1.21, and Figure 1.10). The significance of these statistics seems to be that the sandstone group, which is logically (not to say geologically) more variable in terms of source, shows up as such in these variables.

Two principal components analyses were run, using these three metric variables, to see how well a multivariate function could define the groups. The first analysis used only the two PII Groups, S and T, and was primarily to determine how well temper groups could be placed metrically. The three components generated are dissimilar to many factor runs in that the variance explained is quite similar from component to component (Factor 1--39 percent, Factor 3--28 percent) instead of having one or two very strong factors. The first component loads about equally on diameter and fillet, the second is high on flare, and the third is highly negative on diameter and positive on rim fillet. The correlations between the variables are quite low, the highest being fillet-diameter at $r = 0.168$. The plots of the group members by the three components tend to confirm the similarity suggested by the means and standard deviations.

Group members are quite evenly intermixed on the plot of the first two components, which explains 72 percent of the variance; there are more sandstone group members at extremes, but trachyte items are not far removed. On the third component the S Group tends to have higher values and the T Group lower. As the component has negative loading on diameter--in which T is larger--and positive loading on fillet--in which T is smaller--this plot makes sense. Again, however, there is considerable mixture of groups. All in all, this mixture corroborates the general similarity of the groups.

Table 1.21. Grayware type-temper-surface treatment groups, Pueblo Alto.[a]

ATTRIBUTE/	PII Sandstone Group S		PII Trachyte Group T		PII-III Trachyte Group U	
State	n	Group %	n	Group %	n	Group %
SOOTING/						
Present	35	56.4	38	59.4	19	55.9
Absent	27	43.5	26	40.6	15	44.1
TEXTURE/						
Very fine-fine med.	19	30.6	1	1.6	1	2.9
Medium-medium coarse	22	35.5	23	35.9	23	67.6
Coarse-very coarse	21	33.9	40	62.5	10	29.3
TEMPER GRAIN SIZE/						
Fine	1	1.6	1	1.6	1	2.9
Medium	2	3.2	14	21.9	18	52.9
Coarse	27	43.5	31	48.4	11	32.3
Very coarse	32	51.6	18	28.1	4	11.8
TEMPER DENSITY (%)/						
1-2	13	21.0				
5	21	33.9	11	17.2	6	17.6
10	26	41.9	37	57.8	12	35.3
20	2	3.2	13	20.3	14	41.2
30			3	4.7	2	5.9
SHERD TEMPER/						
None	53	85.4	63	98.4	34	100.0
Less than half	3	4.8	1	1.6		
More than half	5	8.1				
All	1	1.6				
CLAY/						
Sherd combinations	6	15.4				
Tan	6	15.4	7	15.6	5	33.3
Black	15	38.5			1	6.7
White	2	5.1				
Chuska gray			38	84.4	9	60.0
VITRIFICATION/						
Absent	10	16.1	5	7.8	3	8.8
Present	49	79.0	59	92.2	30	88.2
Marked	3	4.8			1	2.9
METRICS:	$\bar{x}$	s.d.	$\bar{x}$	s.d.	$\bar{x}$	s.d.
Diameter	206.3	57.412	228.5	52.012	235.7	67.679
n	58		62		34	
Rim fillet	24.4	6.818	20.3	4.114	20.2	4.823
n	59		64		34	
Rim flare	24.2	6.986	22.7	4.859	33.0	5.905
n	36		42		25	

[a]All groups have narrow coil corrugation surface treatment.

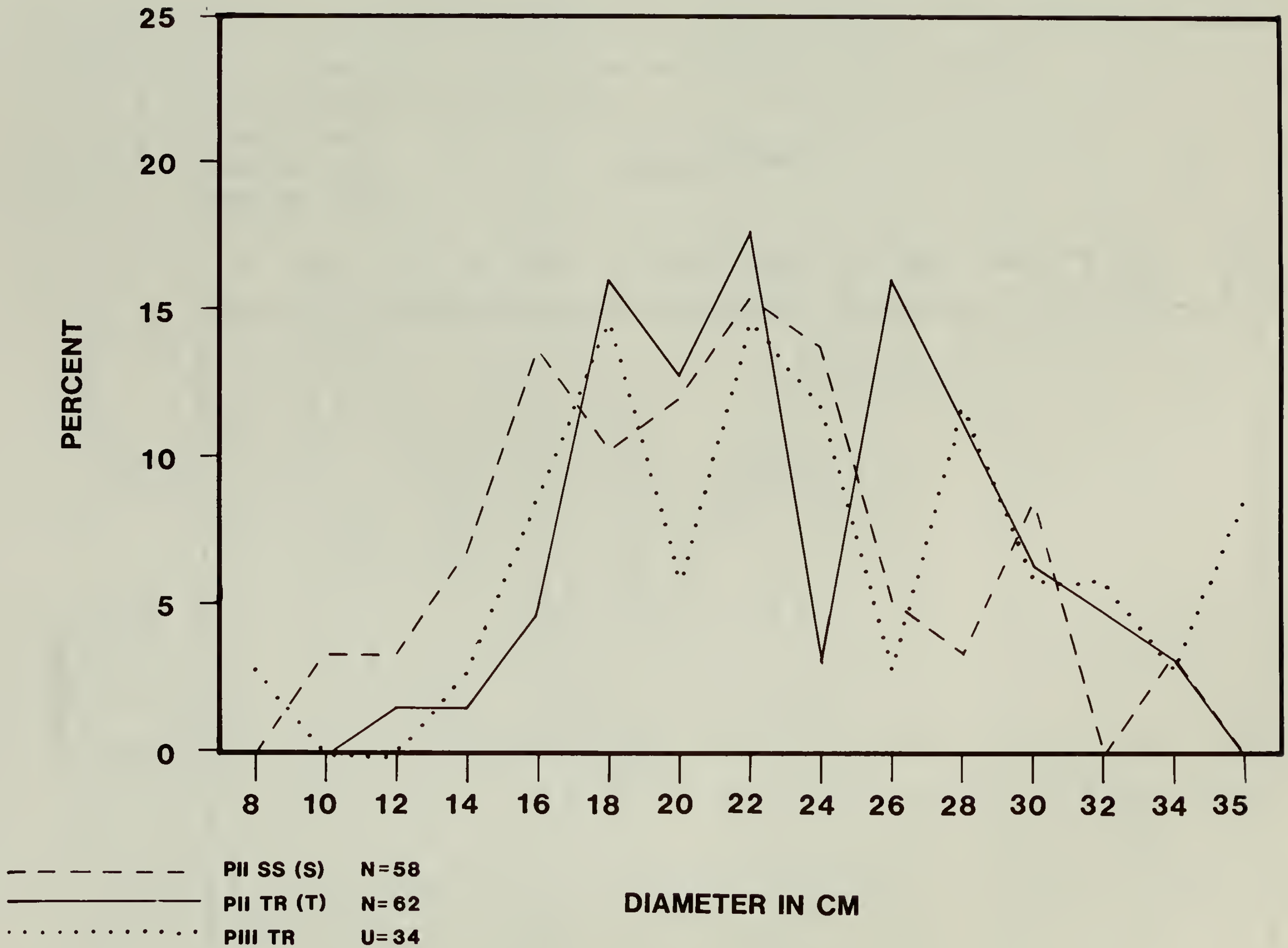

Figure 1.11. Frequencies of jar diameters for grayware temper-surface groups.

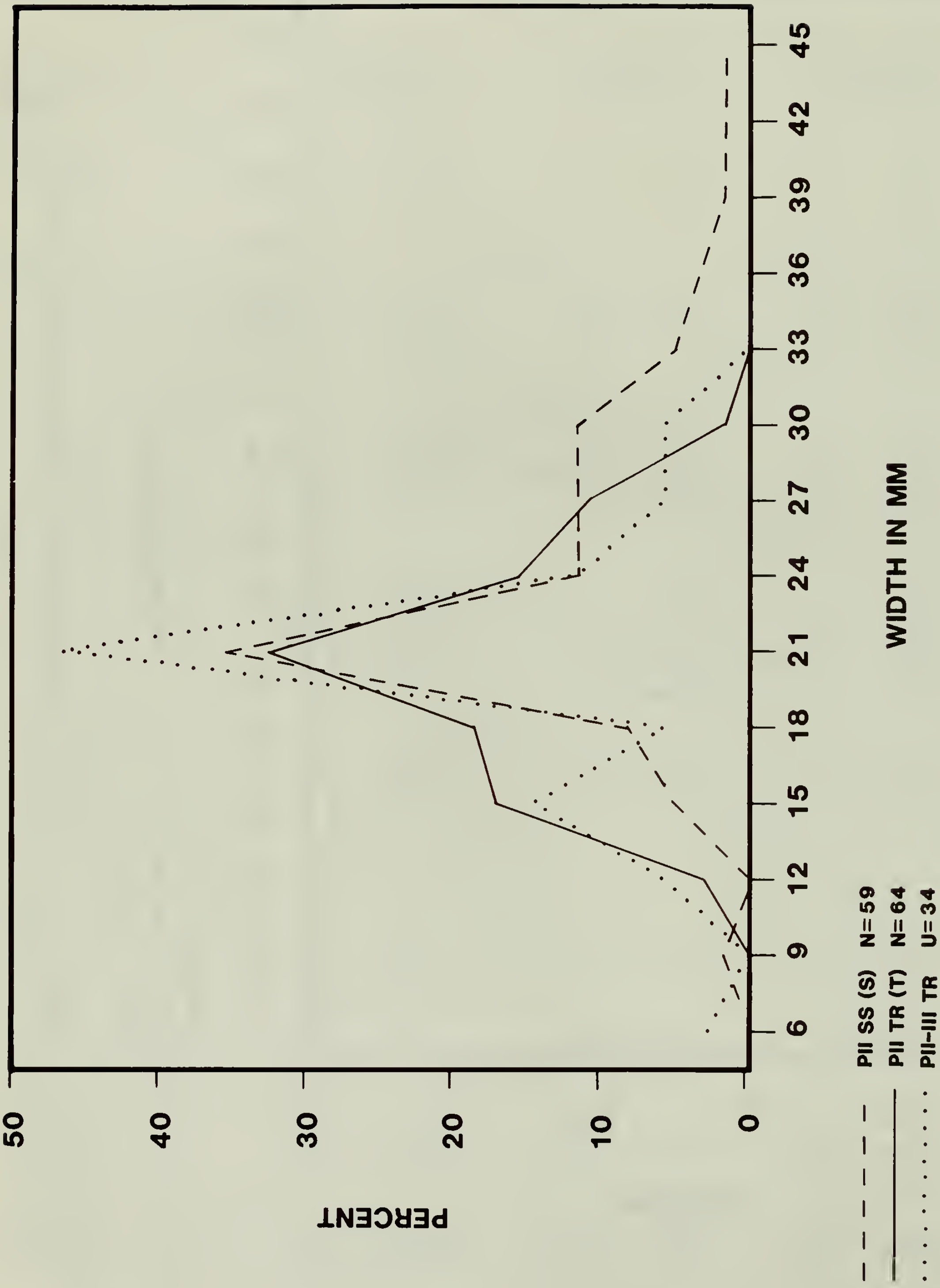

Figure 1.12. Frequencies of rim fillet widths for grayware groups.

The second Pueblo Alto analysis included the PII-III trachyte Group U. The resulting components are similar to those from the first analysis (after all, 84 percent of the sherds are the same) except that, understandably, the relationships of rim flare have changed. Thus flare has a negative loading on Component 1, and Component 1 has larger loading diameter and rim fillet. The U Group members are quite similar on each component: low on Component 1 despite its loading for diameter; high on 2 with its high loading for flare; and intermediate to the other groups on Component 3, which is strongly negative on diameter (which has a large mean and high variance in U), positive on fillet (smallest group mean in U), and low on flare. The U entries may not be strictly partitioned from the S and T members in the plots--equal numbers of both the other groups are mixed with the U members.

The PII corrugated plots and components at 29SJ 627 are similar to those generated for the Pueblo Alto groups except that rim flare is less well-partitioned into a single component. This is like the second Pueblo Alto analysis, and it will be recalled that comparison of means between types at the two sites showed that rim flares were interpreted somewhat differently. At 29SJ 627 as well, however, the similarities between groups within the type PII corrugated led to group members being well mixed on the various plots.

Time Space Analysis

Pueblo Alto is especially well suited to analysis of temporal and spatial patterning because of its good stratigraphy and the horizontal separation of deposits of different age. This is not to imply that there are no problems--samples from deposits of various ages are highly discrepant in size, and absolute dating remains problematic in spite of large numbers of dating samples; although sizable samples are in hand from at least two time segments, very little was recovered from what could be considered primary use contexts. Mixing of deposits is present, but, on the whole, is a minor problem as compared to other Chaco Project sites. As noted in the sample discussion, the temporal discreteness of the deposits has been enhanced in the ceramic sample by the inclusion of units with good spatio-temporal integrity. Thus, while the canyon-wide, time-space matrix is perhaps broad at some sites, the limitations imposed by both excavation location and ceramic sample selection mean that the time-space assignments are quite tight at Pueblo Alto. Often the members of a time-space segment (also referred to below as TS Groups) are all from one provenience (see Table 1.22). Although 38 percent of the 29SJ 627 sample was assigned to groups with spans of over a hundred years (such as A.D. 920-1120), only 6.5 percent of the Pueblo Alto sample was placed in larger spans (A.D. 1020-1220).

The assignment of deposits to time groups is something of an art form which involved primarily Windes' assessment of the relative quantities of various ceramic types in deposits. Study of the ceramics from these time groups is thus, in part, a quantified test of Windes' assessments, and,

Table 1.22. Proveniences and codes for time-space analyses, Pueblo Alto.

A. Time and space codes present

Temporal		Spatial	
Code	Range (A.D.)	Code	Provenience Type
06	920-1020	01	Ramada or living rm fill
07	1020-1120	02	Living room floors
08	1120-1220	03	Storage room fill
10	920-1220	04	Storage room floors
18	1020-1040	06	Pit structure trash fill
21	1020-1220	07	Pit structure fill
		09	Plaza/ramada fill
		11	Trash midden
		14	Miscellaneous

B. Proveniences and sizes of groups[a]

Group Code	Time-Space code	Original T-S codes	n	Description	Proveniences
920-1020					
A	6-1	6-1	36	room fill	Rms 103 (19%) & 110
B	6-6	6-6	79	pitstr trash fill	Plaza Grid 8
C	6-9	6-9	46	plaza fill	Plaza Grid 8
D	6-11	6-11	76	midden	TM Booth 1
1020-1120					
E	7-1	7-1,18-1	102	room fill	Rms 103 (58%) & 110
F	7-2	7-2,7-4, 18-2	173	room floors	Rooms 103 (11%), 110 (88%), 229
G	7-6	7-6	71	pitstr trsh fill	Kiva 13
H	7-7	7-7,18-7	25	pitstr fill	Kivas 10 (92%), 16
I	7-11	7-11	3313	midden	TM Booths 2-6 (48%) TM TT 1 (52%)
1020-1040					
J	18-11	18-11	292	midden	TM Booths 1 & 2 TM TT 1 (75%)
1120-1220					
K	8-1	8-1	40	room fill	Room 103
L	8-6	8-6	762	pitstr trsh fill	Kivas 10 (69%), 16
1020-1220					
X	21-1	21-1,21-3, 21-7,21-9	93	fill	Rooms 103 (78%), 145 (4%), Kivas 10 (4%), 15 (1%), Plaza 1 (11%)
Y	21-11	21-11	220	midden	TM Booth 6 (52%), TM TT 1
Z	21-14	21-14	37	room fill (misc)	Room 109 postoccup.
Total			5,365		

[a]Not shown:
9 with no time space code
1 time-space 6-2
1 time-space 8-2
2 time-space 10-11
2 time-space 21-2
15

particularly on the type level, involves autocorrelations (some idea of the extent to which this is true may be gained from Figures 1.1 to 1.3). The time periods were originally established in blocks of at least 100 years, such as A.D. 920-1020, A.D. 1020-1120, and A.D. 920-1120. After some dispute and reassessment, an additional group, A.D. 1020-1040, was added. This time group, in use at Pueblo Alto, has a schizoid aspect to it--numerically it overlaps with the A.D. 1020-1120 segment, but its intended use is primarily to denote terminal Red Mesa Black-on-white, the main decorated type associated with A.D. 920-1020. The distinction is primarily that deposits considered A.D. 1020-1040 contain some Gallup Black-on-white with Red Mesa still more abundant. Windes says (personal communication) that the early deposits in the Alto Trash Mound are likely to be terminal Red Mesa, falling into the A.D. 1020-1040 group. However, the early Trash Mound ceramics from the construction debris layers were assigned to the A.D. 920-1020 group. The inconsistency that results is this: many A.D. 1020-1040 space groups are small and need to be lumped with others (fill, floor, and pitstructure fill have all been lumped from this time group). The date assignment has been used so that these A.D. 1020-1040 groups are with the A.D. 1020-1120 groups, dividing them from their Red Mesa brethren.

Dates in years A.D. are heavily used in the succeeding discussions. These should not be taken too literally; time segments from the time-space matrix were established early in the course of analysis, and a premium was placed on having segments of equal length. Were dates to be assigned at this point, they would be somewhat different, and insisting on 100-year intervals is unrealistic. Date adjustments are discussed in a later section. What is important here is, first, that the adjustments are not large in terms of years, and, second, with the exception of the A.D. 1020-1040 problem mentioned above, the sequence is the same. In nearly all cases the composition of the groups would be the same--the year label would be the only difference were the system revised. The time groups from the original assignments are retained here for several reasons. These dates are those used in making the assignments, they are those used for other analyses (e.g., Cameron, this volume), and they are those that now exist on the computerized record. Windes has considerably refined the dating in Volume I; a reassessment of the dates is also presented in a subsequent section of this report.

An illustration of both the schizoid and the art form aspects of these groups is that ceramics from Layer 3 of the Trash Mound from two different stratigraphic columns have been placed in two different time groups. The majority of the recovered ceramics from Layer 3 are from Booth 1 and have been put in the A.D. 920-1020 group; those from Booth 2 were assigned to the A.D. 1020-1040 segment on the basis of both type content and location. Because Windes feels the date is not outlandish, because the overlap was not discovered until after the groups were established and partly analyzed, and because the number of sherds is small (11), the sherds were left in the two different groups, except for the booth sequence study where they were reunited. A related inconsistency in time-group placement is present in the backhoe cuts in the Trash Mound's Test Trench 1 and Booth 1. Booth 1 is adjacent to backhoe cut 2 (see

Figure 1.4); in a preliminary assessment, all three backhoe cuts were placed by Windes in the A.D. 920-1020 group, along with all of Booth 1. In the actual computerized asignments, however, the backhoe cuts were placed in A.D. 1020-1040, whereas much of Booth 1 remains in A.D. 920-1020, thereby placing materials from the same natural layers in different time segments.

At 29SJ 627 time, space, and the combination of the two were all presented and analyzed separately. Because the groups at Pueblo Alto are better defined and more inclusive, mostly time-space in combination is presented with no loss of information and little loss of clarity, though it has been found useful to use groups based on time alone in a few instances. As would be fully expected and as indicated in the sample discussion, the quantities of ceramics from different proveniences vary widely, with the Trash Mound contributing 73 percent of the sherds placed in time-space groups. Because the Trash Mound seems to have been deposited quickly, 85 percent of the Trash Mound sherds are placed in the single time group A.D. 1020-1120 (TS Group I, n = 3313; see Table 1.22). In tests involving frequencies, then, this one group sets the standard for the expected; as shall be seen, this generates many significant values because the group seems to be a distinctive one. The other major contributors are trash-filled pitstructures, particularly Kiva 10.

As discussed in the sample section, rooms account for only small quantities of material. Floor sherds from Pueblo Alto are very sparse--only in the time group A.D. 1020-1120 are there enough to form a workable group; in the analysis sample there are two from the time group A.D. 1020-1220 and one each from A.D. 1020-1040 and A.D. 1120-1220. Floor sherds have some conceivable interpretive value, though one may suspect that any ceramic that is not a whole vessel on a floor was serving some function other than that implied by its original form. Non-trash-fill sherds are probably most useful in comparisons as more or less randomized sherds from the site. It is possible that fill sherds represent roof sherds and hence "floor sherds," but their identification is tenuous and their numbers are small.

Comparisons of various time-space groupings on form and ware groups illustrate one important fact in several ways--the main bulk of the Trash Mound (TS Group I) contains more grayware jars than it does bowls of all wares (redware, polished smudged, and whiteware combined, Table 1.23). Of the 14 other time-space groups, 11 show more bowls than gray jars; of the other two groups with more gray jars than bowls, one (Y) is also from the Trash Mound and the other two are the small Groups K and Z, late room fill. In the earliest Trash Mound provenience (D) the ratio of bowls to gray jars is almost one to one, whereas the other proveniences from the same time group are closer to three to one. The A.D. 1020-1040 midden group (J), thus, stands out as anomalous to the rest of the Trash Mound in that the bowl/gray-jar ratio is something less than two to one (Tables 1.23, MF-1.27, and MF-1.28). Concurrent with the decrease in relative bowl frequencies noted for types, the ratios are closer to even in the A.D. 1020-1120 groups, but bowls still outnumber gray jars in nonmidden

Table 1.23. Vessel form contents of time-space groups, A.D. 920-1020 and A.D. 1020-1220 portions plus miscellaneous floor sherds, Pueblo Alto.

	TIME :	A.D. 920-1020				A.D. 1020-1220				16
	SPACE:	Fill	Trash	Plaza	Midden	Fill	Midden	Room	Misc.	Group
Vessel Form	GROUP:	A	B	C	D	X	Y	Z	Floor	Total
White bowl		15	41	29	32	42	69	9	1	1,993
Red bowl		1	2	1	1	2	5	1		119
Smudged bowl		1	7	2		1	1			127
Ladle		1	4	1	4	7	15	4		270
Pitcher			3			2	9		1	173
Seed jar		1								31
Canteen					1	2		1		23
Tecomate							1			23
Olla		1		1	1	4	2	2		154
Mug										1
Duckpot						1				2
Cylinder jar							1			1
Whiteware jar		10	2	1	9	12	25	8		506
Redware jar						2				5
Grayware jar		6	19	11	28	18	91	12	2	1,915
Grayware pitcher							1			4
Miniature			1							13
Gourd jar										1
Totals		36	79	46	76	93	220	37	4	5,361

contexts. Thus some form of special disposal practice is strongly suggested, especially when trash-filled Kiva 13 (TS Group G) is compared to the trash from the midden (discussed further below).

Another typological trend of relevance is the increase of closed whiteware forms, most notably pitchers. These forms are fewer than expected in the Trash Mound in the A.D. 1020-1120 period, but greater than expected in the room fill and floor groups from the same time slot (TS Groups E and F) as well as room fill from the preceding period (A), and the succeeding period (K,Z). Thus, in spite of the difficulties in interpreting fill sherds, these associations suggest again that the Trash Mound may show a specialized deposition, and that closed whiteware forms, being consistently associated with rooms, either were not part of that disposal or were disproportionally used in rooms.

Within the time periods A.D. 920-1020 and A.D. 1120-1220, Chi-square values were not significant at 0.05 for ware distributions; though, by forms, both these groups do show significant differences by provenience group. The A.D. 1020-1120 groups (E-I) do show a difference in ware distributions, with the floors (F) having substantially fewer grayware, more mineral-on-white, and more red and polished smudged wares. This relative paucity of graywares on floors is the opposite of findings at 29SJ 627, 29SJ 1360, and 29SJ 629 where late graywares were relatively abundant on living surfaces. If the Trash Mound were used for disposal of refuse from activities involving disproportional amounts of grayware, it might be further suggested that such grayware activities occurred somewhere other than in the rooms, which led to their lesser representation there. The room sample should, of course, be bigger, and we wish we were discussing whole vessels rather than sherds; nonetheless, the consistency of these trends strongly suggests that behavioral differences between Pueblo Alto rooms and the Trash Mound were, in fact, present.

Division of the various wares (gray, mineral paint, carbon paint) into early and late on the basis of type is potentially a method of checking on relative time assignments. Such divisions in the Pueblo Alto proveniences are so distinct that tests are not possible or necessary. Thus, the A.D. 920-1020 groups are all heavily weighted to the early mineral-painted types (Red Mesa, Black-on-white, and earlier types) and early carbon-painted types (Chuska with Red Mesa design and earlier types); they also display the highest percentages of early graywares (neckbanded and neck corrugated), though the later graywares (PII corrugated on) in the Plaza and pitstructure fill (TS Groups B,C) outnumber the earlier. In view of the location of the deposits--predisposing them to mixture--and the fact that PII corrugated may be expected in deposits dating to circa A.D. 1000, these imbalances need not call the assignments into question. Subsequent time periods show relatively few items falling into the early category, and the later ones show marked increases in carbon-on-white sherds, as per ceramic expectation.

Type comparisons of the somewhat ambiguous groups J (A.D. 1020-1040) and X, Y, Z (A.D. 1020-1220) with adjacent and overlapping time groups show each to be distinctive and, thus, properly placed in separate groups

(Tables 1.24, 1.25, MF-1.28). The type distribution found in Group J differs significantly from that in either the combined AD. 920-1020 proveniences or the combined A.D. 1020-1120 proveniences. Although the presence of early and late types in Group J shows it to be clearly intermediate to the two larger grous, the coefficient of contingency (C) shows the differences to be relatively strong. Groups X-Z have a similar significantly intermediate composition when compared to the combined A.D. 1020-1120 groups (E-I) and to the A.D. 1120-1220 groups (K-L). Groups X-Z have substantially more carbons than do E-I and less than K-L. The more purely late K-L groups contain relatively less mineral-on-white and more smudged and red wares. The coefficient of contingency is larger in the X-Z to K-L comparison than in the X-Z to E-I test; this is, in part, a sample-size artifact but suggests that X-Z may be more like A.D. 1020-1120 than A.D. 1120-1220, though, again, the separation of the groups seems warranted.

Granting beginning dates for Gallup and Puerco of circa A.D. 1030, the separation of the A.D. 1020-1040 group from both the A.D. 920-1020 and A.D. 1020-1120 groups seems to have some merit. Group J contains approximately equal amounts of Red Mesa and Gallup, whereas the groups temporally on either side heavily favor one or the other. The A.D. 1020-1120 groups contain relatively little Red Mesa--the quantities may generally be attributed to holdover vessels--suggesting that in practice the A.D. 1020-1120 group might start closer to A.D. 1040. The general absence of Chaco McElmo also may mean the terminal date is more like A.D. 1100 than A.D. 1120. It is important to remember that the groups, rather than the date labels, are important, though putative lengths of periods affect consumption estimates.

Form distributions across time groups tend to support the finding of X-Z as similar to E-I for no significant difference is found in a test of that pair by bowl, ladle, special closed (pitcher, seed jar, canteen, tecomate), jar/olla, and gray jar. It will be remembered that Y and Z are similar to I in the higher percentage of gray jars than bowls; Y and I are both midden proveniences. Lumped TS Groups X, Y, and Z and K-L, on the other hand, do differ significantly from one another because of fewer bowls and more gray jars, special closed, and ladles in X, Y, and Z. The 100-year time segments on either side of A.D. 1020-1120 each differ significantly from that group, again because of its emphasis on graywares. In addition to more bowls than expected, the later K-L group shows high percentage of pitchers. In the case of forms, the A.D. 1020-1040 group (J) is quite similar to the A.D. 920-1020 groups (A-D), in contrast to the type comparison.

As noted in the grayware type discussion, the rim flare of utility jars is generally believed to increase in eversion through time. Segmentation of the sites' deposits into time-related groups allows an examination of how well this trend holds up and a back-check on time assignments. As can be seen from the means below (Table 1.26) and the frequency plots (Figures 1.10, 1.13), the trend in flare measurements and the time assignments "do what they are supposed to." The overlapping time groups A.D.

Table 1.24. Contents of time-space groups, A.D. 920-1020 and A.D. 1020-1220 portions plus miscellaneous floor sherds, Pueblo Alto.

TIME :	A.D. 920-1020				1020-1220				16
Rough Sort Type / SPACE: / GROUP:	Fill A	Trash B	Plaza C	Midden D	Fill X	Midden Y	Room Z	Misc. Floor	Group Total
Plain Gray				5					29
Wide Neckbanded	1	2	1	3					17
Narrow Neckbanded	2	5	2	5		1	1	1	110
Neck Corrugated	1	2	2	8	1				24
PII Corrugated	1	4			12	10	3		392
PII-III Corrugated					3	3			115
PIII Corrugated									46
Unid. Corrugated	1	6	6	7	2	78	8	1	1,184
TOTAL GRAY	6	19	11	28	18	92	12	2	1,917
BMIII-PI Unpol. M/w						1			2
Early Red Mesa B/w	4		1	1	1	1			21
Red Mesa B/w	15	31	19	31	7	8	4		313
Escavada B/w				1	5	2	1		142
Puerco B/w				1	4	14	3		285
Gallup B/w			1	1	15	41	7		1,040
Chaco B/w						3			41
Exotic M/w	1			3	5	5	2	1	137
PII-III M/w	4	15	7	8	6	34	3	1	618
TOTAL M/w	24	46	28	46	43	109	20	2	2,599
BMIII-PI Pol. C/w	1								1
PII-III C/w					10	1			98
Mesa Verde B/w					1				4
Chaco McElmo B/w					3		1		76
Chuska B/w					3	2			81
Chuska Whiteware	1	1	1		4	1	1		138
Red Mesa desn Chuska	2	3	2	1	2				29
Tusayan Whiteware					1	3			44
TOTAL C/w	4	4	3	1	24	7	2		471
Unid. Whiteware		1	1		3	6	2		
TOTAL WHITEWARE	28	51	32	47	70	122	24	2	3,187
Plain Red						1			4
Decorated Red	1	2	1	1	4	4	1		124
Polychrome									4
TOTAL REDWARE	1	2	1	1	4	5	1		132
Polished Smudged	1	7	2		1	1			130
Brownware									3
GRAND TOTALS	36	79	46	76	93	220	37	4	5,369
PERCENTAGE	0.7	1.5	0.9	1.4	1.7	4.1	0.7	0.1	

[a]Not shown: 11 with no time-space assignments

Table 1.25. Contents of time-space groups, A.D. 1020-1220 portion, time groups of 100 years or less, Pueblo Alto.[a]

TIME :	A.D.1020-1120					A.D.1020-40	A.D.1120-1220		16
Rough Sort SPACE:	Fill	Floors	Trash	Pit fill	Midden	Midden	Fill	Trash	Group
Type GROUP:	E	F	G	H	I	J	K	L	Total
Plain Gray					17	7			29
Wide Neckbanded	2				3	4	1		17
Narrow Neckbanded	1	2			73	17			110
Neck Corrugated					8	2			24
PII Corrugated	6	24	2	1	298	11	5	15	392
PII-III Corrugated			8	2	26		3	70	115
PIII Corrugated	1				12			33	46
Unid. Corrugated	17	26	14	4	875	47	8	84	1184
TOTAL GRAY	27	52	24	7	1,312	88	17	202	1,917
BMIII-PI Unpol. M/w								1	2
Early Red Mesa B/w	2	1			5	5			21
Red Mesa B/w	8	4	5		109	67		5	313
Escavada B/w	2	3	2	2	92	4	1	27	142
Puerco B/w	6	10	8	1	200	8	3	27	285
Gallup B/w	26	55	9	2	776	54	6	47	1040
Chaco B/w	3	2	1		23		1	8	41
Exotic M/w	4	1	2	2	73	3	2	33	137
PII-III M/w	12	19	5	3	400	40	1	60	618
TOTAL M/w	63	95	32	10	1,678	181	14	208	2,599
BMIII-PI Pol. C/w									1
Red Mesa desn Chuska	1	1		1	12	3		1	29
Chuska B/w	1	2	3	2	48	3	3	14	81
Chaco McElmo B/w					1			71	76
Chuska Whiteware	2	3	2	1	56	1	1	63	138
PII-III C/w			1	1	8		1	76	98
Mesa Verde B/w								3	4
Tusayan Whiteware	1	2	—	—	23	1	2	11	44
TOTAL C/w	5	8	6	5	148	8	7	239	471
Unid. Whiteware	2	2	3		60	11		26	117
TOTAL WHITEWARE	70	105	41	15	1,886	200	21	473	3,187
Plain Red								3	4
Decorated Red	1	6	1	2	51	1	1	47	124
Polychrome	—	—	—	—	—	—	—	4	4
TOTAL REDWARE	1	6	1	2	51	1	1	54	132
Polished Smudged	4	10	5	1	63	3	1	31	130
Brownware					1			2	3
GRAND TOTALS	102	173	71	25	3,313	292	40	762	5,369
PERCENTAGE	1.9	3.2	1.3	0.5	61.7	5.4	0.7	14.2	

[a]Not shown: 11 with no time-space assignment.

Table 1.26. Mean corrugated rim flare through time.

Time (A.D.)	Mean	s.d.	n	Range
920-1020	18.4°	6.828	7	11-27
1020-1040	24.7°	4.878	10	19-32
1020-1120	24.8°	8.094	269	6-72
1020-1220	27.0°	9.008	15	9-37
1120-1220	35.0°	7.986	98	13-52

Table 1.27. Mean diameter by time segment.

Time (A.D.)	Mean (mm)	s.d.	n	Min-Max
(white bowls)				
920-1020	192.5	61.067	82	35-350
1020-1040	203.9	60.830	114	90-350
1020-1120	200.1	66.521	911	40-350
1020-1220	200.6	63.344	77	85-350
1120-1220	198.5	64.516	259	40-350
(gray jars)				
920-1020	194.0	42.516	30	110-300
1020-1040	198.0	48.762	45	80-300
1020-1120	210.6	59.939	734	70-350
1020-1220	206.1	62.346	61	70-330
1120-1220	215.0	57.817	179	70-350

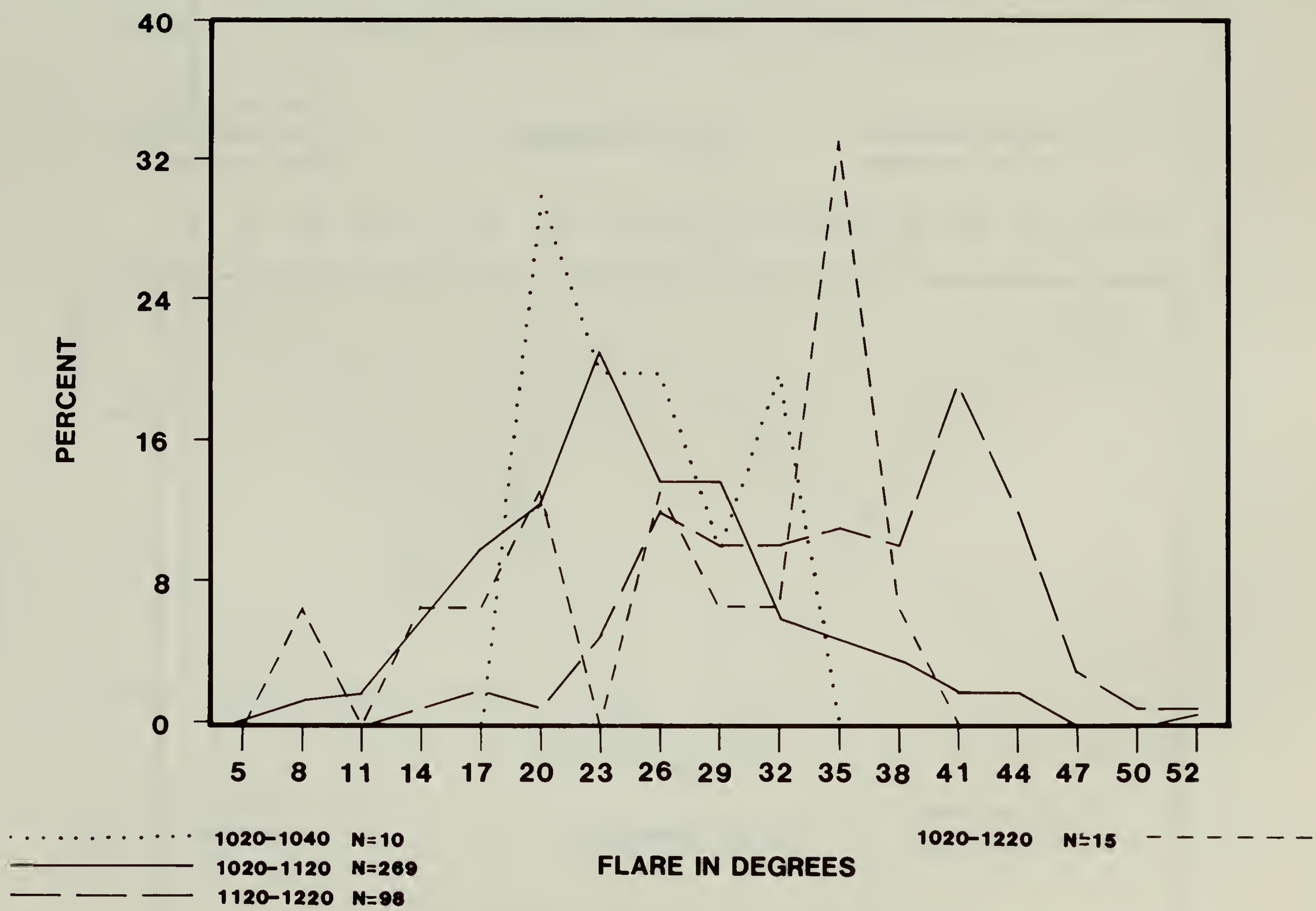

Figure 1.13. Grayware jar rim flare frequency by time group.

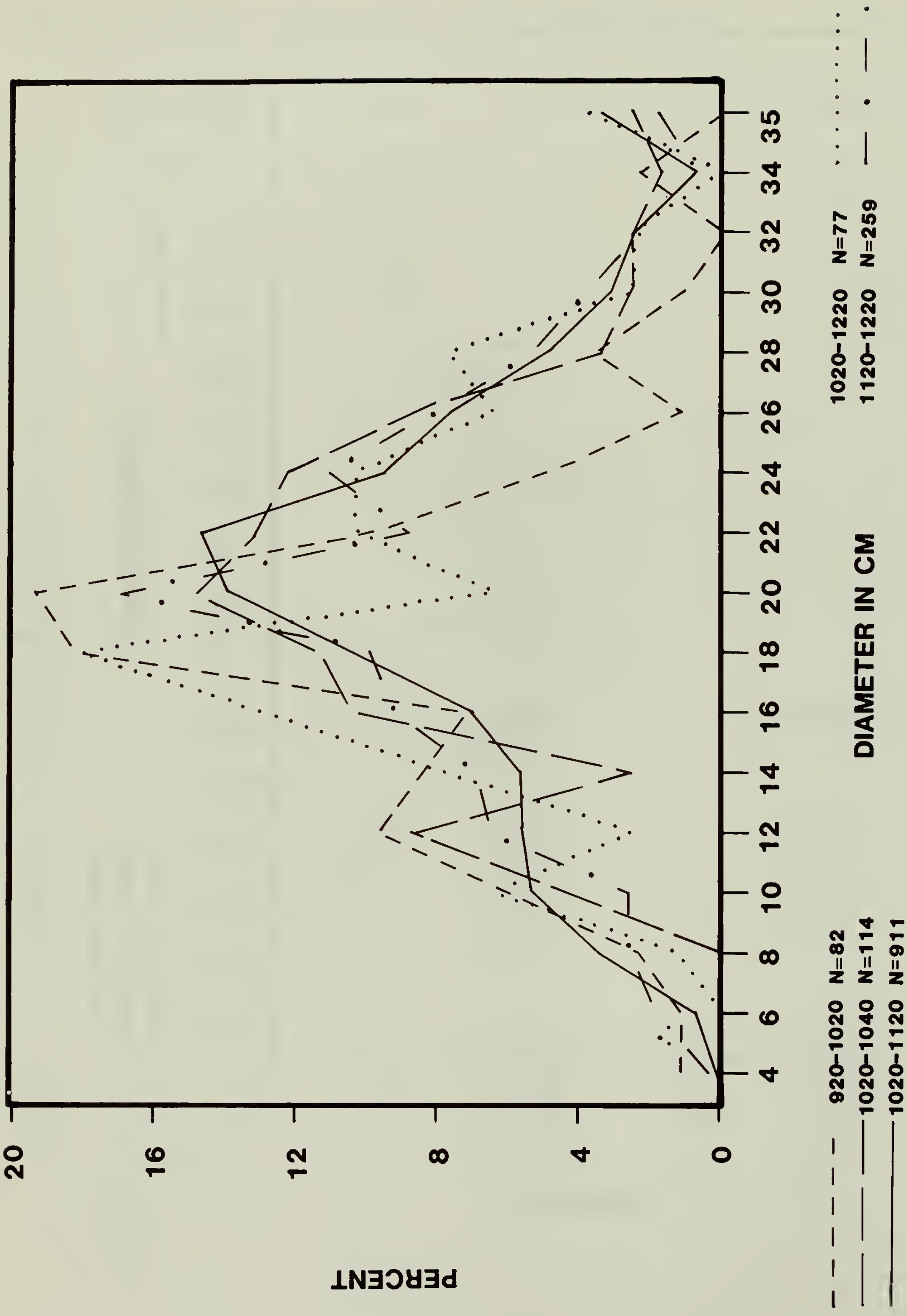

Figure 1.14. Whiteware bowl diameter frequency through time.

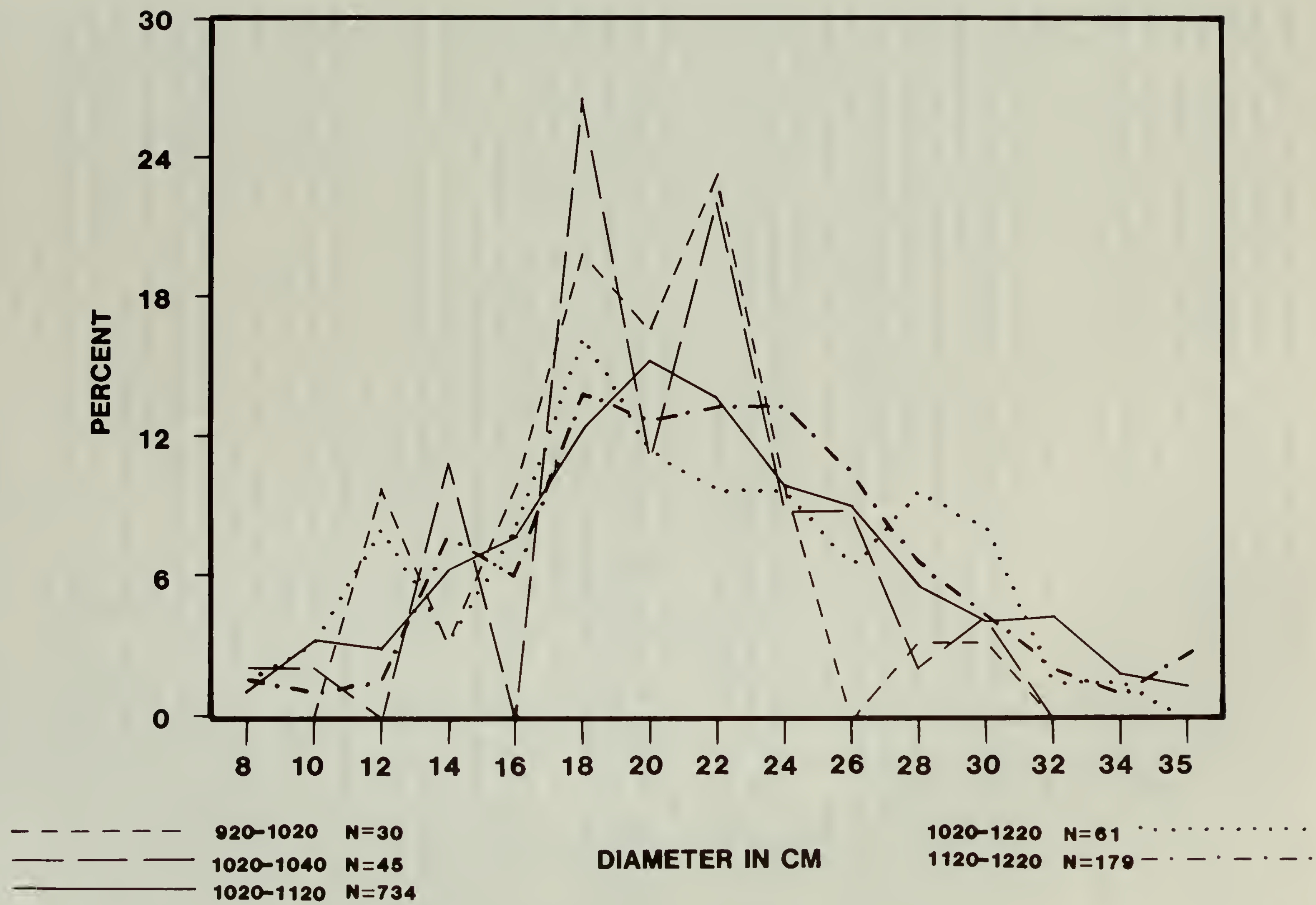

Figure 1.15. Grayware jar diameter frequency by time groups.

1020-1040 and A.D. 1020-1120 have virtually identical means, though the larger A.D. 1020-1120 group is more variable. Both of these groups' means are within two degrees of the mean for PII corrugated as a group ($\bar{x}$ = 22.9°); the latest group is about the same as that for the PII-III corrugated type from the site ($\bar{x}$ = 31.9°). Once again, because time periods are assigned to a considerable degree on the basis of ceramics, this "back-check" is circular to a similar degree; nonetheless, the time-flare trend seems to be in effect here.

Another trend noted in the type descriptions is that bowls from both 29SJ 627 and Pueblo Alto show an increase in diameter through typological time. Both grayware jars and whiteware bowls were examined for diameter trends through time by means of the time segments. Treating time groups instead of primary type groups reflects the type sequence for whiteware bowls, but mutes the differences. Although the Gallup-dominated A.D. 1020-1120 group would be expected to have the largest mean, the A.D. 1020-1040 group does; however, the overall trend of mean bowl diameter is one of increase and slight decline, as it is in the types. The differences are small in terms of actual size, and the frequency distribution (Figure 1.14) shows that all time groups are most abundant in the 17-22.5 range. The A.D. 1020-1120 group does have the largest modal value, as well as the greatest coefficient of variation.

Gray jar diameters exhibit a more direct trend and a slightly greater dimensional change than do the bowls (Table 1.27, Figure 1.15). The mean diameter increases steadily through the time segments, with the latest segment's mean slightly more than 2 cm greater than that of the earliest. The two earliest segments lack vessels in the upper end of the range. Both the bowl- and jar-diameter plots suggest multimodality in some of the time segments, but in each vessel class the segments containing the most members have smooth curves approximating normal distibutions (Figures 1.14, 1.15). The similarity of mean bowl and jar diameters suggests that there may be some functional or structural factor at work, but this can be nothing more than a suggestion.

Vessel form contents of similar deposits in different time groups prove to be different in midden and room fill contexts and similar in trash-filled pitstructures (Tables 1.23, 1.25). Several aspects of the similarity through time in pitstructures further suggest the distinctiveness of the main Trash Mound (basically TS Group I). All three trash-fill, time-space groups (B, G, L) show the bowls-more-frequent-than-gray-jars relationship common to proveniences outside the Trash Mound. Speculatively, then, if the Trash Mound represents disposal from a specialized function, the pitstructure dumps--common trash areas in smaller sites--represent the refuse from household activities. Following that line further, we can say that household refuse seems to have remained similar before, during, and after the formation of the Trash Mound.

The greatest weakness in this argument is the relatively small size of our sample from Kiva 13 (TS Group G) and our inability to know its precise temporal and disposal relationship to the large mound. That is,

granting that the two deposits are contemporaneous, it may be that Kiva 13 served as a disposal area for a small subset of the Pueblo Alto users, such as a group of permanent residents, whereas the Trash Mound may have been used only for special events involving nonresidents. On the other hand, trash disposal may not have been nearly so formalized. The absence of a deposit analogous to the Trash Mound for the A.D. 1120-1220 period and the conformance of the heavy trash in Kiva 10 (TS Group L) to other pitstructure deposits may be provisionally interpreted as the absence of that special function during the latest occupation represented in our sample.

Room fill was found to be relatively low in gray jar content and high in whiteware closed forms, and, on that basis, we postulated that gray jar functions had been somewhat displaced by a relocation of grayware-related activities. However, if interpretation of the pitstructure as daily refuse receptacle is correct, the gray jar-Trash Mound association stands, and it need only be said that grayware still had a place in living rooms, though perhaps less than in other periods.

A change in the relative frequencies of red and smudged wares is best seen in the late Group L deposit. All the deposits of any size assigned to earlier time slots contain more polished smudged than redware vessels (with the exception of petite TS Group H). There is a marked reversal in the test deposit (L), echoed in TS Groups X and Y. All four of the polychrome sherds in the analysis come from the late, trash-fill, pitstructure Group L; all are from Kiva 10 and all are Tusayan polychrome--three Citadel and one Cameron Polychrome (see Redware Distribution in following section).

The non-trash-fill groups (A, E, K, X) differ in form content by time group but not in a readily interpretable way. The A.D. 1020-1120 group E has a lower frequency of bowls than expected, perhaps in accordance with the lower frequency of bowls found in contemporary types. The overlapping groups X (A.D. 1020-1220) and K (A.D. 1120-1220) show reversed high frequencies--although X contains relatively more bowls, K contains relatively more gray jars (K is one of the nonmidden groups with more gray jars than white, red, and smudged bowls). The earliest Group A conforms to the expected; both A and K are small groups (Table MF-1.28).

On the whole, time-temper patterns follow trends that are seen consistently in Chaco Canyon. As some form-time associations have been demonstrated and as temper-ware associations are well-known, some duplication of similarities and differences of the form and ware tests would be expected. However, no significant differences were found within time groups and across proveniences (Tables 1.28, MF-1.28). Differences do exist across time periods. The A.D. 1020-1040 Group J differs from the A.D. 920-1020 groups (A-D) in having more trachyte-sandstone mix. San Juan tempers from these two time segments are too infrequent to test, but they are more abundant in the earlier segment (3 percent as opposed to 1 percent). Group J, in turn, differs from the A.D. 1020-1120 groups (E-I) in having relatively more chalcedonic sandstone temper and less trachyte than E-I.

Table 1.28. Pueblo Alto lumped temper types found in time-space groups.[a]

Time-Space Group (A.D.)	Sand-stone	Sherd> SS	Chalc. SS	Fe-bearing SS	San Juan	Trachyte	SS-Trachyte	Unident. Igneous	Total
920-1020									
A--room fill	12	14	1		1	6	1		35
B--pitstruct fill	28	24	8		2	10	3	2	77
C--plaza fill	13	18	2		3	9			45
D--midden	23	31	3	1	1	13	4		76
1020-1120									
E--room fill	23	37	2		4	25	6	4	101
F--room floors	40	48	10	1	6	51	11		167
G--pits. trsh fill	15	21	3	2	1	27	2		71
H--pitstr. fill	7	8	1		2	4	3		25
I--midden	455	509	68	10	52	621	140	43[b]	1,898
1020-1040									
J--midden	74	89	17	5	1	60	23	5[b]	274
1120-1220									
K--room fill	7	9	1			18	2	1	38
L--pits. trsh fill	159	238	12	1	13	241	62	25[b]	751
1020-1220									
X--fill	19	30	1	1	9	23	5	4[b]	92
Y--midden	28	30	3			38	11	4	114
Z--room fill	12	14	2	1	1	6	1		37
Miscellaneous floors	3				1				4
Totals	918	1,120	134	22	97	1,152	274	88[b]	3,805
Percentage	24.1	29.4	3.5	0.6	2.5	30.3	7.2	2.3	

[a]Not shown: 26 "Tusayan sandstone" in TS Groups E,F,I,J,K,L,X (see Tables 4-2,3) (see type/time-space tables);
1 shale temper in Group I;
12 sherds with unobservable temper.

[b]Indicates addition of 5 Socorro temper items--all are single items except Group L with 2.

The comparison of E-I with the A.D. 1120-1220 segment (K-L) suggests that the quantities of trachyte have stabilized, as neither the sanstone-dominant nor the trachyte-dominant category deviates much from the expected. Percentages of chalcedonic sandstone decline as they do in all the preceding time-segment comparisons. The later segment contains more sandstone and less sherd tempering. Sherds from 29SJ 633 suggest that an increase in San Juan tempering materials could be expected late in Chaco ceramics (Toll et al. 1980), but the proveniences included here in the latest group (K-L) show fewer San Juan items than those from the preceding segment (E-I). The ceramics showing the San Juan increase at 29SJ 633 unquestionably are later than those from Pueblo Alto, which places the influx of San Juan pottery quite nicely. Strictly delimiting this cross-time test to the trash deposits predictably gives very similar results.

The only test in which iron-bearing sandstones were numerous enough to be included also conformed to a previously identified pattern. The Trash Mound deposits from A.D. 1020-1040 and A.D. 1020-1120 differ significantly, in part because of discrepancies discussed above, but the greater percentage of iron-bearing sandstones in earlier Group J also contributes. Following the results of the form tests, J and D are not different, nor are the broader Groups X and Y different in temper content from their spatial counterparts E and I. Trash Mound Groups I and J do differ, as do trashed pitstructure Groups B (A.D. 920-1020), G (A.D. 1020-1120), and L (A.D. 1120-1220). The latter result echoes the trends established in earlier tests--increasing trachyte and decreasing chalcedonic sandstone and undifferentiated sandstone. Less conformably, Group G contains less than the expected frequency of sandstone-dominant/trachyte mix and the highest percentage of dominant trachyte of the three groups. Because the form complements in these three trash fill groups did not differ significantly, this lower occurrence cannot be attributed to greater frequencies of graywares.

Logically, the higher sandstone-dominant/trachyte frequency would be expected in the latest group (see the Type, Temper, Surface section), but the difference is not apparent in the comparison of the two major trash deposits (I and L) where the occurrence of this temper mix in the earlier group is only slightly (0.9 percent) smaller than TS Group L. TS Groups G and I--trash from the same time period but in different contexts--also do not differ statistically in temper content, though I fits the pattern of increased sandstone-dominant/trachyte mix occurrence better than does G.

We have seen that the percentages of both sandstone-dominant and trachyte-dominant trachyte/sandstone mixes are higher in the hachured types than in the solid element Cibola types, which suggests that some difference in type composition may exist between the trash in Kiva 13 and that in the Trash Mound (as has also been suggested on the basis of gray jar occurrence). In TS Groups J, E, F, and I solid element types (Escavada and Puerco) comprise 19-27 percent of the Cibola types associated with this time group, with the broader time-midden group Y being 32 percent solid element types; the remainder in each group are hatched types Gallup and Chaco Black-on-white (Tables 1.24, 1.25). In Group G the solid ele-

ment types are half of the Cibola types. Interestingly, the other trashed pitstructure unit (Kivas 10 and 16, TS Group L) also is evenly split between solid and hatched mineral-on-white types (the high Chaco McElmo counts in L serve to inflate its sandstone-dominant/trachyte mix frequency). Again, Group G is lamentably small, so this can only be a suggestion; but perhaps there is something to the hachure-Trash Mound association; that the fill and floor proveniences (TS Groups E and F) are also dominated by hachure within the four Cibola types makes the suggestion that much more tentative.

Ceramic Trends in Major Trash Proveniences

As indicated earlier, the time-space groupings are designed for cross-site comparison. Although useful in viewing intrasite distributions as well, they are coarser than necessary in a site with well-defined deposits such as Pueblo Alto. Examination of stratigraphic sequences, particularly of the Trash Mound and Kiva 10, directs attention to various finer-level trends than have thus far been addressed. Superficially, this section is organized into discussions of the internal ordering of these two, major, trash proveniences, but other, linking proveniences are drawn in, and much of the discussion is necessarily comparative, so that considerable information of relevance to the Trash Mound is found in the subsequent Kiva 10 analysis.

Internal Analysis of the Trash Mound

It has been shown that Pueblo Alto's Trash Mound is somewhat distinctive in its ceramic content; its well-defined stratigraphy and large quantities of sherds make it well-suited to further analysis. The small percentage of the Trash Mound excavated by the project provided more ceramics than did excavations in all of the rest of the site. Testing of the Trash Mound proceeded in two phases. The first was to excavate a deep, narrow, Test Trench I running northwest-southeast (Figure 1.16). Especially because of unfortunate slumping, provenience information for the very large quantity of material generated by this trench is less than optimal--at best it is in 2 x 0.75 m, 20-cm-deep, arbitrary levels, but parts can only be assigned to very broad portions of the trench.

The second phase of excavation was to place a series of stratigraphic columns ("booths" for short) in the southwest wall of Test Trench 1 (Figure 1.17). The provenience information for this material is clearly far preferable. McKenna processed the entire rim sample from the Test Trench, but only a portion of that sample was examined for temper (see Sample section). This "internal analysis" uses only the booth material; of the 115-plus layers defined in the Test Trench 1 profile, 62 are represented by ceramics in this sample from the booths. As only 66 layers are represented by ceramics, the 62 in the final-analysis sample are an adequate representation.

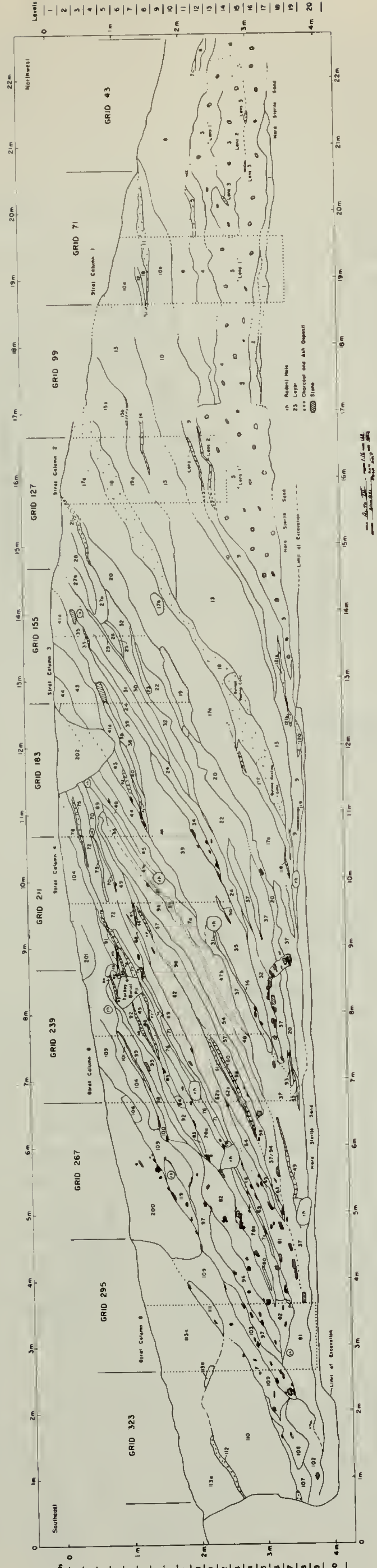

Figure 1.16. Test Trench 1, northwest-southeast.

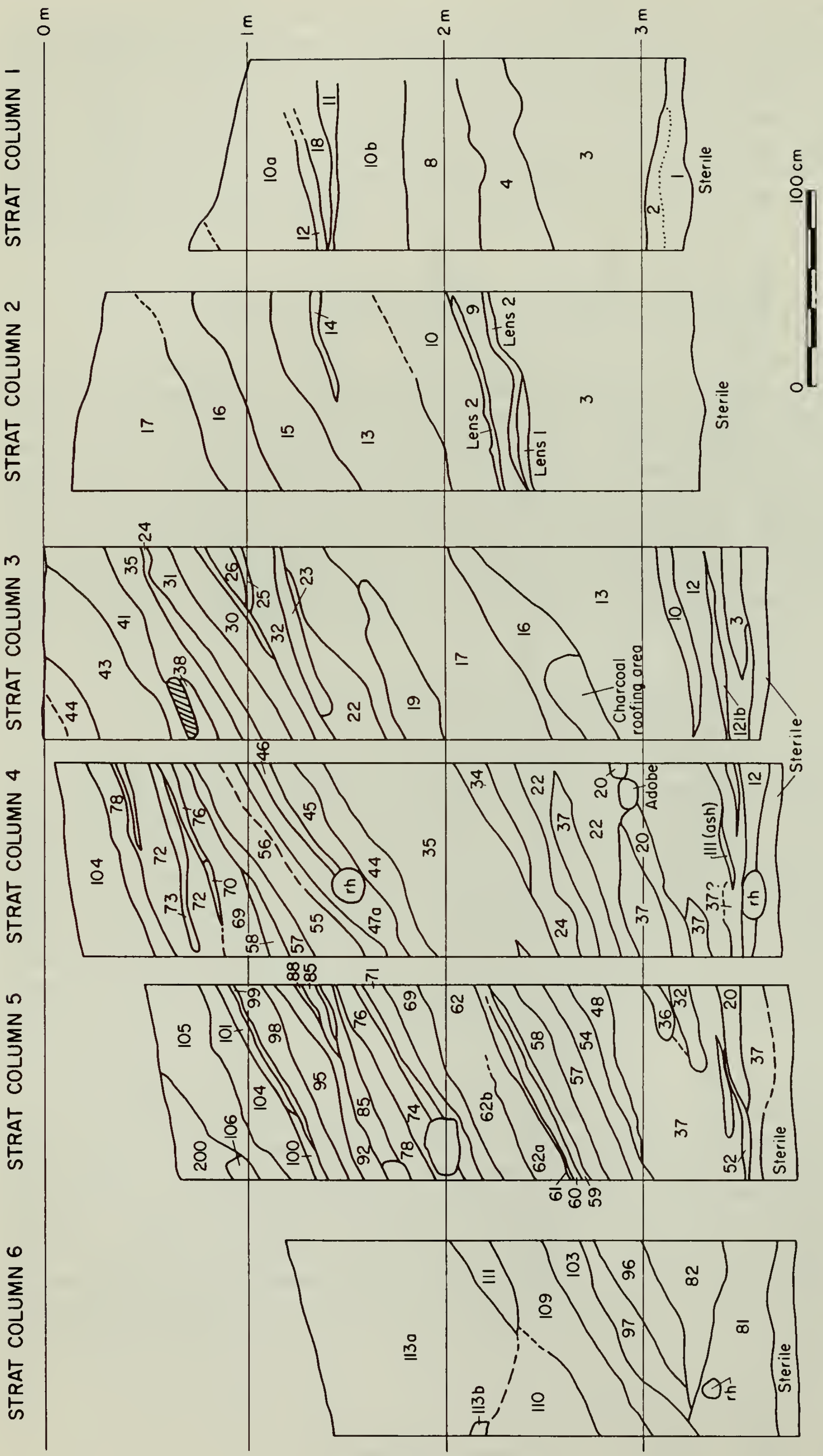

Figure 1.17. Test Trench 1, booths.

This analysis will take two forms here as follows.

1) Most of the layers in the Trash Mound yielded insufficient numbers of ceramics for meaningful comparison of all layers individually, but the booths serve as reasonable chronological segments of layers. The booths were placed so that most of the layers defined in the profile would have some portion excavated as natural layers, rather than the arbitrary levels of the longer trench. The layers of the Trash Mound slope down to the east considerably, so that no layer extends the entire length of the trench. Especially because all the booths were not excavated to the bottom, there is very little duplication of layers between booths. Thus, the booths form groups of layers that are in sequence, with Booth 1 earliest and Booth 6 latest (Figure 1.17). Seven layers are found in two booths. As can be seen below, in each case where a layer was cut by two booths, one of the two booths always contains more material from the layer than the other booth. By placing the layer with the booth containing the majority of layers sampled, the booth sequence remains quite close to the stratigraphic sequence.

Layer	Booth	Sherd n	Booth	Sherd n	Placed with
3	1	40	2	11	Booth 1
10	1	8	2	6	Booth 1
44	3	17	4	36	Booth 4
69	4	34	5	13	Booth 4
76	4	29	5	6	Booth 4
78	4	4	5	19	Booth 5
104	4	31	5	35	Booth 5

Layers 3 and 10 are very thick, construction-debris layers, Layer 3 being the bottom layer at the northwest end of the trench (Booths 1 and 2); 10 is much thicker in Booth 1 than in Booth 3. No layer is common to the excavated portions of Booths 2 and 3. Layer 44 occurs only at the very top of Booth 3, and is, thus, logically lumped with Booth 4. Likewise, Layers 78 and 104 are at the top of the Booth 4 column and go well with Booth 5. As defined, both Layers 69 and 76 are peculiarly shaped, 76 stopping altogether between the booths; both are low in the Booth 5 sequence but not basal. One other possible exception to the sequential nature of the booths is that a mixed layer (Layers 41 and 35) is present at the top of Booth 3 (61 sherds), whereas Layer 35 is the lowermost excavated layer of Booth 4 (130 sherds). With these adjustments the booths make an acceptable, if not quite perfect, sequence and are so used here.

(2) N. J. Akins (1982 and this volume) has assigned seasonality to most of the layers in the Trash Mound booths according to percentages of cottontails, jack rabbits, and prairie dogs. She recognizes that there can be problems with such assignments, but feels that there is a reasonable chance that they approximate season of layer deposition. Although ceramics have no known, seasonally determined attributes, it is likely that vessel usage differed seasonally, particularly if use of the site itself was to some degree seasonal. At the least, ceramics may be used to

determine if the layers given seasonal assignments have identifiable ceramic associations or if they vary randomly. More optimistically, it might be possible to embellish Akins' seasonal interpretations. On Akins' advice two sets of tests were performed:

(a) winter versus other, because she has more confidence in "winter" identifications; and

(b) winter, spring, fall, and construction.

Ambiguous layers were left in the "other" category. Layers 1-8 contain distinctive assemblages of fauna (Akins 1982:Table 4.90) and ceramics (Red Mesa and neckbanded), and are further distinguished by virtue of high rubble content; these layers have been kept separate in both levels of tests and labelled "construction."

Booth Sequence

The type contents of the booths (Tables 1.29, MF-1.29) support their placements in the time-space matrix (Table 1.22). Booth 1 contains very high percentages of Red Mesa and neckbanded vessels. With the removal of Layers 3 and 10 from Booth 2, the small remaining sample looks quite similar to Booths 3, 4, and 5. Booth 6, placed in the broader A.D. 1020-1220 segment, does contain relatively high frequencies of the later type Chaco Black-on-white and the only examples of PII-III corrugated; Escavada Black-on-white is also disproportionately frequent. Again, carbon-on-white types are scarce; Booth 5 contains the majority of all three, later, carbon-paint types--Chuska Black-on-white, Tusayan whiteware, and Chuska whitewares (of which Chuska Black-on-white is one)--in the Trash Mound booths. The localization of Tusayan whitewares in the Trash Mound resembles the occurrence of Tusayan in Kiva E at 29SJ 627. Although there are some similarities between the type assemblages of Kiva E and Booth 5, it is quite evident that a considerably broader time span is represented in Kiva E--there is (as always at 29SJ 627) a large group of Red Mesa Black-on-white, as well as PIII corrugated, which is absent in the booths and rare in the Trash Mound as a whole. Inclusion of Booth 1 in a Chi-square test of type lumps shows significant differences, but a test of only Booths 3-6 does not (Table MF-1.29).

The primary vessel forms found in the booths are remarkably consistent from booth to booth (Tables 1.30, MF-1.29). Booth 1 is higher on bowls and lower on gray jars, and, at the other end of the trench, Booth 6 is the reverse, but the overall similarity is great enough that the Chi-square is insignificant at 0.05. Reducing the test to the four later booths (3-6) does yield a significant Chi-square value because of the higher frequency of ladles in Booth 3, gray jars in Booth 6, and closed whiteware forms in Booths 4 and 5. The differences from booth to booth among the later four are not great enough or regular enough to merit much interpretation, but some indications of trends may be noted. There is a decline in the percentage of the vessel form assemblage that is ladles; Booth 6 shows a jump in the pitcher percentage, as well as the gray jars.

Table 1.29. Type frequencies found in the Trash Mound booth sequence, Pueblo Alto.

Rough Sort Type	Booth 1	Booth 2	Booth 3	Booth 4	Booth 5	Booth 6	Total
Plain Gray	10	3	6	5	4		28
Wide Neckbanded	4		1				5
Narrow Neckbanded	9	3	6	9	7	4	38
Neck Corrugated	8		1				9
PII Corrugated	2	4	22	18	23	31	100
PII-III Corr.						4	4
Unid. Corrug.	12	16	87	148	130	135	528
TOTAL GRAY	45	26	123	180	164	174	712
Early Red Mesa B/w	4					1	5
Red Mesa B/w	31	1	2	3	4	9	50
Escavada B/w	1	1	3	2	6	12	25
Puerco B/w	4	3	25	25	38	24	119
Gallup B/w	13	21	87	122	109	74	426
Chaco B/w		1	2	2	8	13	26
Exotic M/w	3	1	6	11	13	15	49
PII-III M/w	10	5	40	36	22	17	130
TOTAL M/w	66	33	165	201	200	165	830
Chuska B/w		1		9	9	5	24
Chuska Whiteware		1	3	4	11	6	25
Red Mesa desn Chuska	1		5				6
Tusayan Whiteware			3		6	1	10
TOTAL C/w	1	2	11	13	26	12	65
Unid. Whiteware			5	1	2	2	10
TOTAL WHITEWARE	67	35	181	215	228	179	905]
Redware	1	2	6	6	4	3	22
Polished Smudged		2	3	2	10	5	22
Brownware					1		1
GRAND TOTALS	113	65	313	403	407	361	1,662
PERCENTAGE	6.8	3.9	18.8	24.2	24.5	21.7	

Table 1.30. Form, grayware sooting, and rim flare found in Trash Mound booths, Pueblo Alto.

	Booth 1	Booth 2	Booth 3	Booth 4	Booth 5	Booth 6	Total
VESSEL FORM							
White bowl	38	19	82	120	108	86	453
Red bowl	1	2	5	6	4	3	21
Smudged bowl		2	3	2	9	5	21
Ladle	5	3	18	13	9	9	57
Pitcher	1		11	9	9	19	49
Seed jar			2	2	1	1	6
Canteen	1		3	1	1	2	8
Tecomate			2		1	2	5
Olla	1	2	6	2	10	5	26
Whiteware jar	21	11	58	66	87	55	298
Grayware jar	45	26	123	180	165	174	713
Miniature					3		3
Totals	113	65	313	401	407	361	1,660
GRAYWARE SOOTING							
Sooted	20	12	77	95	82	72	358
Unsooted	25	14	46	85	83	102	355
Totals	55	26	123	180	165	174	713
CORRUGATED RIM FLARE							
Mean	27.0	21.0	22.8	21.0	24.3	28.6	
standard deviation	--	3.464	6.274	5.508	4.497	6.544	
number	2	3	8	13	14	22	62

On the whole, grayware is usually around 40 percent or more in the mound, and bowls are fairly constant at around 30 percent, with a hint of a decline. If the fill from Kivas 10 and 16 (TS Group L) is regarded as the succeeding step in a sequence, the suggested trends find only one continuation. Pitchers remain at about 5 percent in TS Group L, but bowls and ladles are both up (52 percent and 5 percent), and gray jars are down (27 percent). This serves to reemphasize that the Trash Mound is a distinctive deposit.

Sample sizes are insufficient to allow much testing of design distributions, but inspection of the more common designs in lumped Puerco and Escavada and in Gallup suggest some changes (Table 1.31). Even in the scant Puerco-Escavada group, band designs and ticked triangles occur disproportionately often in the early booths as do barbs, sawteeth, and wide-line Sosi design in the later booths. The former are a common Red Mesa design combination, suggesting an actual and/or classificatory design transition into Puerco-Escavada. The latter are a Sosi complex, also seen in carbon-on-white wares. The hachures in Gallup yield an insignificant Chi-square, but hachures B-1 and B-3 (hatch lines equal in weight to framing lines and widely spaced hatch) are weighted in the earlier booths whereas B-4 and B-6 (closer hachure lines) B/C (close squiggle hatch with heavy framers) are more abundant in the later booths. Corner-filled triangles are infrequent, but, according to typological expectation, do occur in the highest percentages in the first two booths and the smallest in the last.

In accordance with the occurrence of PII-III corrugated jars in Booth 6, the mean rim-flare of corrugated jars (neckbanded excluded) is a standard deviation larger than any of the other booths (see Figure 1.18). Booths 3 and 4 have nearly similar rim-flare means, and Booth 5 has a somewhat larger mean, provisionally suggesting a trend of increase. The trend is of some interest in that it occurs strictly within the rough-sort type PII corrugated (plus what few unidentified corrugated sherds may have been measurable).

The booth sequence reveals few surprises about temper composition (Table 1.32). The early end of the sequence (Booth 1) is distinguished by a high frequency of sandstone and less trachyte in all types of occurrence (pure and sand/trachyte mixes). The incidence of chalcedonic sandstone in Booths 4 and 5 (4.2-4.9 percent) is slightly higher than expectation based on the idea that this temper associates most strongly with Red Mesa and neck corrugated ceramics. The bulk of chalcedonic sandstone temper is found in the graywares in the three later booths, whereas it is more evenly split--though infrequent--between the mineral and gray wares in the earlier booths. Booth 4 stands out from the others in also having the highest percentages of trachyte in both mineral-on-white sherds and gray ones, though Booths 3-6 all have over half trachyte-tempered grayware. In the case of temper, the four later booths show no statistical difference for all wares combined (Tables 1.32, 1.33, MF-1.29).

There is an intriguing cyclical pattern in the booth sequence's occurrence of sooted grayware. The two earliest booths show more unsooted

Table 1.31. Puerco-Escavada and Gallup frequencies of common designs in Trash Mound booths, Pueblo Alto.

Rough Sort	Booth 1	Booth 2	Booth 3	Booth 4	Booth 5	Booth 6	Total
PUERCO+ESCAVADA							
Parallel lines	2		1	2	5	1	11
Scrolls	2		1		3	1	7
Dotted lines		1	1		1		3
Parallelograms			1	1	4	1	7
Checkerboards			7	2	5	1	15
Sawteeth		1		1	4	4	10
Barbs			2	2	7	7	18
Elongated scalloped tri.				1	4	2	7
Sosi, wide line				3	7	9	19
Heavy curvilinear lines				2	2	2	6
Solids in band	3		4	5	4	5	21
General solid		1	9	3	3	5	21
Solid ticked triangles	2	2	4	4	5	5	22
Interlocked ticking			1		2	2	5
Other hachure			1	1	1		3
PUERCO+ESCAVADA TOTALS	9	5	32	27	57	45	175
(All designs in type in booth)	9	6	36	35	63	55	201
GALLUP							
Corner triangles	2	1	4	4	4	2	17
Hatched band design	1		1	2	4	4	12
General solid			3	4	4	1	12
Hachure B-1	6	6	10	17	19	15	73
Hachure B-3	3	5	10	12	8	5	43
Hachure B-4	2	5	32	45	39	27	150
Hachure B-6	2		11	8	14	8	43
Hachure B/C		1	9	17	12	9	48
Hachure C			3		4	3	10
Hatched checkerboard	1		3	2	1	1	8
Other hachure		2	6	15	5	3	31
Heavy Gallup squiggle		2	3	4	4	3	16
Solid ticked triangles			3	3	2	3	11
GALLUP TOTALS	17	22	98	133	120	84	474
(All designs	18	23	111	158	136	100	546)

Table 1.32. Temper frequencies by ware in Trash Mound booths, Pueblo Alto.

	Booth 1	Booth 2	Booth 3	Booth 4	Booth 5	Booth 6	Total
Grayware							
Undifferentiated SS	22	7	47	60	57	66	259
More sherd than SS	1	2	4	3	4	7	21
Chalcedonic SS	1	3	2	14	14	8	42
Iron-bearing SS	1	3	2	2	4		12
San Juan igneous			1	2		1	4
with sandstone			1				1
Trachyte	19	10	53	87	76	78	323
with sandstone	1	1	11	11	7	14	45
SS dominant			2				2
Unidentified igneous				1	2		3
Totals	45	26	123	180	164	174	712
Mineral							
Undifferentiated SS	10	7	31	36	32	26	142
More sherd than SS	46	13	85	91	97	82	414
Chalcedonic SS	2	1	3	3	6	1	20
San Juan igneous			2	1	1	1	5
with sandstone				1	1	1	3
sandstone dominant			1		4	2	7
Trachyte		1	8	5	7	10	31
with sandstone	1	4	13	32	16	16	82
sandstone dominant	6	7	22	28	32	21	116
Unidentified igneous	1		4	5	6[a]	7	27
Totals	66	33	169	202	202	167	839
Carbon							
Undifferentiated SS						1	1
Tusayan SS			3		6	1	10
Trachyte	1	2	7	8	13	6	37
with sandstone			1	5	6	2	14
sandstone dominant					1	1	2
Unidentified igneous						1	1
Totals	1	2	11	13	26	12	64
TEMPER--total							
Undifferentiated SS	32	14	78	97	92	93	406
More sherd than SS	47	17	91	95	106	95	451
Chalcedonic Sandstone	3	4	5	17	20	9	58
Iron-bearing sandstone	1	3	2	2	4		12
Tusayan sandstone			3		6	1	10
San Juan igneous		1	7	9	4	2	23
with sandstone	1		2	1	2	1	7
sandstone dominant		1	1		4	2	8
Trachyte	20	13	68	100	96	94	391
with sandstone	2	5	25	48	29	32	141
sandstone dominant	6	7	24	28	33	22	120
Unidentified igneous	1		6	6	11[a]	10	34
Totals	113	65	312	403	407	361	1,661

[a]Includes one Socorro temper

Table 1.33. Chi-square comparisons of the Trash Mound, Kiva 16, and Kiva 10, Pueblo Alto.

Table	Test Entries	n	Controlling Group	Table Dimensions	x2	d.f.	p	C	Small
	Kiva 16 gray, carbon, mineral, red/p-sm by level	234		3 x 4	3.430	6	0.753	.120	1 cell <5
1.29, 1.34	Booth 6, Kiva 16, K10 L4 by gray, C/w, M/w, red/p-smudged	630	57% Booth 6	3 x 4	80.605	6	0.000	.337	1 cell <5
1.30, MF-1.35	Booth 6, K16, K10 L4 by all bowls, ww closed, gray jar	639	55% Booth 6	3 x 3	26.239	4	0.000	.199	--
1.32, 1.35	Booth 6, K16, K10 L4 gray-ware by sandstone, trachyte	289	55% sandstone	2 x 3	28.392	2	0.000	.299	--
1.34	Kiva 10 all levels but L4 by gray, M/w, C/w, red/pol. smudged	475		4 x 6	14.237	15	0.508	.171	--
1.34	Kiva 10 levels by gray, M/w, C/w, red/polished smudged	545		4 x 7	32.830	18	0.018	.238	--
1.34	K16, K10 above L4 by gray, M/w, C/w, red/pol. smudged	676	70% Kiva 10	2 x 4	26.935	3	0.000	.196	--

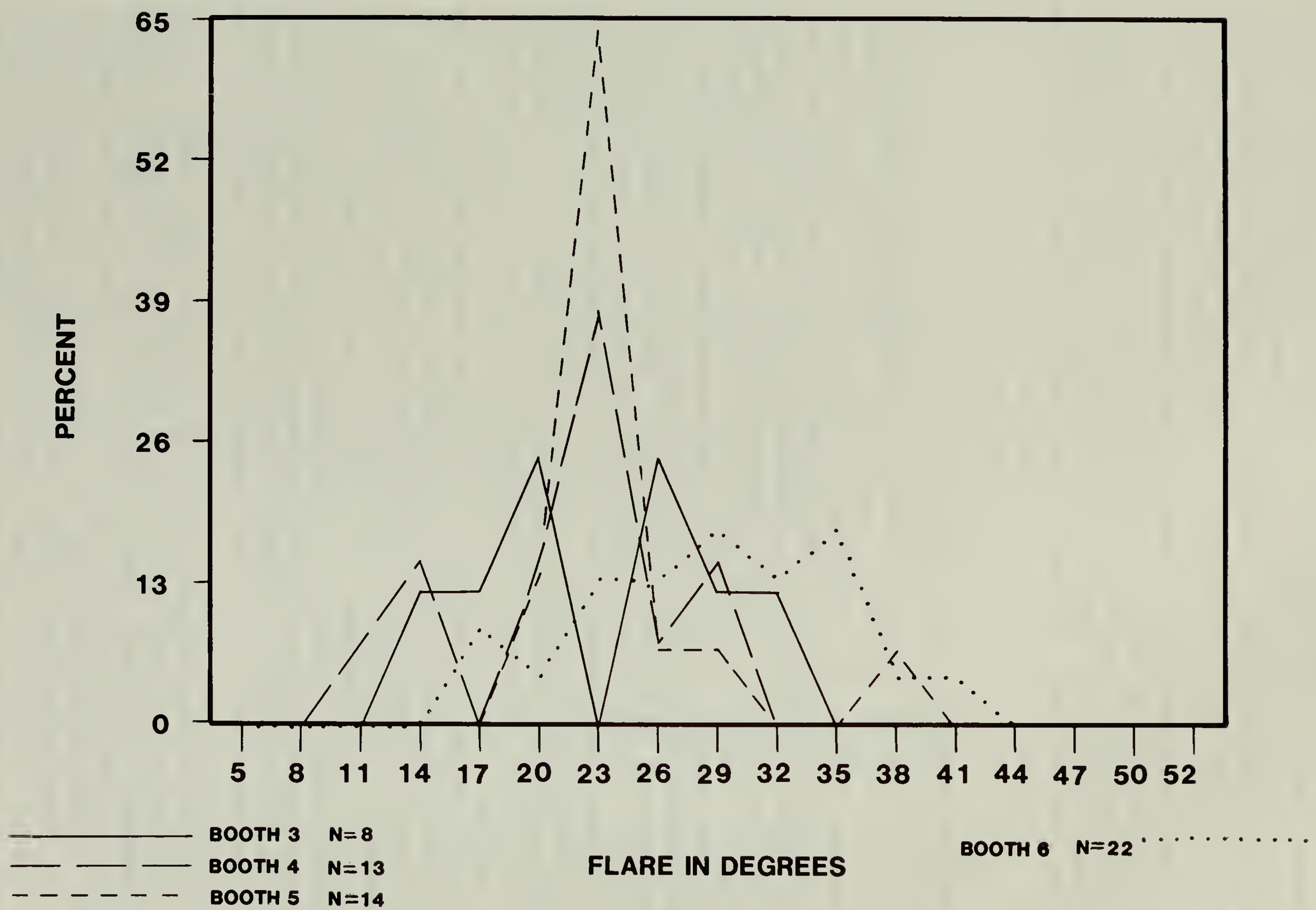

Figure 1.18. Grayware jar rim flare frequency in Trash Mound Booth sequence.

than sooted items, which is in accordance with the smaller site pattern and earlier contexts at Pueblo Alto--all the A.D. 920-1020 and A.D. 1020-1040 groups at Pueblo Alto are dominated by unsooted graywares (see Sooting in next section). The middle of the sequence contains more sooted than unsooted items with Booth 4 followed by a decline in sooted items to the level of the early end. Once again regarding the later trash as the next step, there is another reversal of the internal Trash Mound trend, for the late kivas contain 57 percent sooted graywares. McKenna points out that much of the contents of Booth 6 comes from Layers 109 and 113, which are the result of weathering from the top of the mound. The sherds here, then, may have been exposed longer and therefore show less sooting; furthermore, the contents of Booth 5 are nearly half soot and half no soot.

Faunal Seasonal Assignments and Ceramics

Akins fully recognizes that seasonal assignments using fauna must be tentative, and she has withdrawn some of her classifications (personal communication, 1985). The assignments, however, do provide a different means of grouping ceramics, and the following analysis uses her seasonal groups as originally formulated. Perhaps corroborating her subsequent doubts, there are very few significant differences among the seasonal groups and the differences that can be found center on the presence of more gray jars in the layers with faunal assemblages suggesting winter deposition (Tables MF-1.30, MF-1.31). The composition of the winter group is somewhat unusual in its high proportion of unidentified grayware, which indicates that the vessels are more fragmented as well as more abundant. Excluding unidentified grayware, the winter and spring groups have the two highest white-to-gray-ware ratios, whereas including it, winter has the lowest and spring the highest white:gray ratios. The ratios are quite constant from group to seasonal group when all graywares are considered, but are much more erratic with the exclusion of the unidentified items. PII corrugated occurs in statistically similar frequencies both in the seasonal groups and Booths 3-6 when compared to unidentified corrugated (as argued earlier, most of the unidentified corrugated is likely to be PII corrugated). The addition of whitewares to the comparisons, however, gives a significant Chi-square value with unidentified gray and white wares having the main deviations from the expected, and with the PII corrugated contributing little. In short, then, the winter layers are characterized by more grayware (presumably more broken up) the spring layers by more whitewares, and the fall--appropriately enough--in between.

As noted by Akins, different parts of the Trash Mound tend to have high concentrations of layers with faunal assemblages that may indicate various seasons. Fall layers concentrate in Booths 1-4, winter in Booths 4-5, and the few spring layers are in Booth 5. The seasonal assignments, thus, have a considerable chronological component, and, in fact, some of the results from the booths and the seasonal layers are similar (Table MF-1.29). Booth 6 contains the highest percentage of graywares, but it is little used in the seasonal tests, and contains <u>no</u> winter layers. Because

the winter layers are concentrated in Booths 4 and 5, which were found in the booth tests to deviate most from the expected by having high percentages of closed whiteware forms, it is suggestive that the winter layers are as high in graywares. If grayware concentrations can be isolated from proveniences characterized by whiteware, perhaps credence is given both the technique of seasonal assignment and the ware-season association.

In keeping with booth findings, the seasonal layers do not differ in temper composition. In keeping with the type findings, the major form difference among seasonal layers is in gray jars. The winter layers have relatively small frequencies of whiteware jars and ollas, suggesting very tentatively a reduced need for water, possibly because of cooler temperatures, changing site use or population, or some combination of these. There should be some correspondence between sooting occurrence and season —an intuition stemming from not entirely ethnocentric visions of some warm rabbit stew on a cold winter's night. An association does exist between the seasonal assignments and presence of sooting--in this case, the fall and winter groups are slightly above expected and the spring lower.

In summary, the Trash Mound ceramics in the postconstructional portion of the deposit are a rather homogeneous group relative to the site as a whole, but they also appear to have accumulated over a sufficiently long time span for there to be discernible trends in their attributes. When one further considers that the whole mound bridges the shift from dominant Red Mesa Black-on-white to dominant Gallup, and the last layers show a distinct increase in the percentage of Chaco Black-on-white and the appearance of a few, later, carbon-on-white vessels, the impression of time depth is enhanced. The last layers also exhibit an appreciable increase in the degree of flare of corrugated rims. Although specific changes in ceramic decoration can, of course, take place instantaneously, these types of assemblage shift seem likely to have been gradual and, therefore, argue against extremely rapid accumulation of the Trash Mound.

At the same time, the volume of the Mound might lead one to expect an even longer accumulation period than the ceramics suggest. The presence of some Gallup and some (though perhaps less than expected) PII corrugated in the earliest booth and the infrequency of types earlier than Red Mesa indicate that the earliest deposits in the Trash Mound are toward the end of the production of Red Mesa--probably A.D. 1000 or later. The presence of a large number of tree-ring dates of A.D. 1044-1045 (ring dates), probably from a burned roof, at the equivalent of the base of Booth 3 forms a reference point. Thus, basal Booth 3 is clearly no earlier than A.D. 1045 and probably somewhat later, as the roof was presumably in place for at least a little while. By far the most abundant type in the Trash Mound is Gallup Black-on-white, placed by convention at A.D. 1030-1200, though Breternitz (1966:76) places it at A.D. 1000-1125. If, inception dates of around A.D. 1070 for Chaco Black-on-white and A.D. 1100 for Chaco McElmo are correct, the terminal phases of the Trash Mound can be placed at around A.D. 1100 (Breternitz 1966:71 places Chaco Black-on-white as early as A.D. 1050, but separation of Chaco from Gallup Black-on-white is chronically difficult and inconsistent).

Chaco Black-on-white is present in the later layers of the mound, but Chaco McElmo is extremely rare, corroborating the placement of Chaco Black-on-white earlier than Chaco McElmo. The graywares in the mound indicate that extra rim eversion did not commence until around this terminal Trash Mound period. The latest tree-ring date from the Trash Mound is A.D. 1072vv from the vicinity of upper Booth 5. Once again if we assume some lag for cutting to use to Trash Mound and add a few years for missing rings, these latest deposits are reasonably placed at circa A.D. 1100. If these somewhat scant chronometric inferences are correct, then, the Trash Mound appears to have taken, at most, about 100 years to form. Certainly, these few "real" dates are in accordance with the ceramic dates currently employed.

Internal Analysis of Kiva 10

The latest and second largest trash deposit partially excavated by the project was in Kiva 10, located in front of the center of the North Roomblock (Volume I: Figure 1.4; Volume II: Figure 2.38). The deepest levels of this deposit (referred to below as Layer 4) contain a type assemblage that suggests they were deposited shortly after the latest layers in the Trash Mound--the mineral-painted whiteware count is still greater than the carbon-painted count, but the percentage of carbon-on-white is greater in the basal Kiva 10 levels than in any portion of the Trash Mound. In all overlying deposits in Kiva 10, the carbon-on-white outnumbers the mineral-on-white in our sample. The later date of Kiva 10's filling is also suggested by the presence of PIII and PII-III corrugated in all levels.

The material removed from Kiva 10 was from a trench bisecting the north half of the structure. The trench was excavated in arbitrary 20-cm levels; the stratigraphy was then defined in profile. Many of the arbitrary levels cut more than one of the four gross natural layers defined, but levels can be paired to create units from single, natural layers (see also McKenna 1980), with interstitial level groups (Levels 17, 20-22, and 25-26 cross natural layer boundaries). The correspondence between level groups and layers is as follows:

Levels	Layer	Fill Character
14-16	1	Structural rubble; Level 16 includes much of Surface 1
17	-	Crosses Surface 1
18-19	2	
20-22	-	20 crosses Surface 2
23-24	3	Trash
25-26	-	Similar to Layer 3
27-28	4	Fill to the first structural floor

The most secure comparisons are, of course, between natural layers, but the profile shows no major disturbances, and the natural layers are not

nearly as sloped as those in the Trash Mound, so even the levels form a sequence of sorts. Lekson (excavation supervisor for Kiva 10) does note that heaping was apparent in the profile, so no equivalence of level to layer may be assumed.

Unfortunately, the collection from the bottom layer of Kiva 10 is smaller than might be wished, but it is noteworthy that Escavada Black-on-white is more abundant than either Gallup or Puerco Black-on-white. This is an unusual circumstance at Pueblo Alto and elsewhere, and the small sample makes it suspect, but an increase in percentage of Escavada is also present in Trash Mound Booth 6 (though Gallup is much more numerous than Escavada in Booth 6). In subsequent Kiva 10 levels, Gallup is once again more abundant than Escavada, though all three of the Escavada-Gallup-Puerco triad are much reduced, and little discrepancy is present among the three (Table 1.34).

The type composition visible in Table 1.34 for the carbons is sketchy because of the use of rough-sort types for uncommon types, carbon-on-white being relatively uncommon in Chaco in most time periods. The carbon-painted wares are fairly evenly split into three groups in Kiva 10: the Chuska wares (which here include "Mesa Verde Black-on-white"), Chaco McElmo, and PII-III Carbon-on-white. Reference to the more refined types from the bulk counts (ironically, the "rough sort") provides a reasonably good idea of the types present (see Table MF-1.32). Of the carbon-on-white in the Kiva 10 detailed analysis sample, 39 percent are identified as Chuskan wares. As can be seen in the final-analysis tables, Chuska Black-on-white--similar to Gallup in its use of hachure--occurs in frequencies similar to Gallup's in Kiva 10. Although Chuska Black-on-white is present in the Trash Mound, it is vastly outnumbered by Gallup; it may be surmised, then, that either Chuska Black-on-white remained in production later than Gallup [Windes (1977:319) places it at A.D. 1000-1125] or, more probably, its importance relative to Gallup's increased, along with other ceramics from the Chuska Valley. The other Chuskan carbon types in Kiva 10 (included in "Chuskan whiteware" in Table 1.34) are mainly Toadlena and Nava Black-on-white. Windes dates Toadlena as contemporaneous with Chuska Black-on-white, and the bulk counts for the Trash Mound (in both Booths 3-6 and the Test Trench) and upper Kiva 10 are remarkably similar--Chuska Black-on-white is 48-49 percent of the identifiable Chuska carbons and Toadlena is 25-30 percent. The Kiva 10 detailed-analysis sample counts suggest that the bulk counts for Chuska Black-on-white may be inflated--that is, the vessel count shows Chuska comprising a considerably smaller portion (19 percent) than does the bulk count.

The difference between Chuska carbon types found in the Trash Mound and those found in Kiva 10 is that whereas in the Trash Mound "Newcomb/Burnham" (carbon paint, Chuskan Red Mesa, more or less) is the third most abundant Chuska type, in Kiva 10 Nava is, with Nava rare in the Trash Mound and Newcomb/Burnham rare in Kiva 10. It should be stressed that the items in Kiva 10 that appear as Mesa Verde Black-on-white are trachyte-tempered, which makes them Crumbled House Black-on-white. Ceramics in the Mesa Verde Black-on-white style with temper other than trachyte (such as San Juan igneous or sand and sherd) were not recovered from Pueblo Alto.

Table 1.34. Type frequencies found in the Kiva 10 levels and layers, Pueblo Alto.

Rough Sort Type	Layer 1	Level 17	Layer 2	Levels 20-22	Layer 3	Levels 25-26	Layer 4	Total	Kiva 16
PII Corrugated	1	3	1	1	4		3	13	3
PII-III Corrugated	2	6	4	6	6	14	10	48	24
PIII Corrugated	2	2	5	1	8	4	1	23	10
Unid. Corrugated	7	12	4	4	7	10	8	52	36
TOTAL GRAY	12	23	14	12	25	28	22	136	73
BMIII-PI unpol.									1
Red Mesa B/w			1	1				2	3
Escavada B/w	1	1	1	1	3	4	11	22	7
Puerco B/w	2	1	2	1	1	5	3	15	13
Gallup B/w	2	2	4	2	5	7	4	26	24
Chaco B/w			1	1				2	6
Exotic M/w	5	4	5	6	2	3	3	28	7
PII-III M/w		12	9	7	3	5	6	42	21
TOTAL M/w	10	20	23	19	14	24	27	137	82
Red Mesa desn Chuska				1			1	2	
Chuska B/w	1		2	2	4	2	3	14	2
Chuska Whiteware	4	5	14	10	13	12	1	59	6
Tusayan Whiteware		1		1				2	9
Chaco McElmo	8	16	7	10	7	13	1	62	10
PII-III C/w	5	7	12	9	12	11	4	60	18
Mesa Verde B/w	2					1		3	
TOTAL C/w	20	29	35	33	36	39	10	202	45
Unid. Whiteware	1	3	1	1	1	1	1	9	17
TOTAL WHITEWARE	31	52	59	53	51	64	38	348	144
Redware	5	7	4	2	6	14	7	45	7
Polychrome			1		1		2	4	
Polished-smudged		2		7	7	3	2	21	11
Brownware				1				1	1
GRAND TOTALS	48	84	78	75	90	112	71	555	236
PERCENTAGE	8.6	15.1	14.1	13.5	16.2	20.2	12.3		

The other carbon-on-white group in Kiva 10 is Pueblo II-III Carbon. Bulk counts are less helpful in this group as any item with carbon paint that was neither Chuskan, Tusayan, nor Chaco McElmo was assumed to be from the Mesa Verde series. Such an assignment is verifiable through temper in less than 10 percent of such sherds from Pueblo Alto (see Table MF-1.4). About 20 percent of sherds from this category are trachyte-tempered, and the rest contain tempers with no firm sourcing value (the 12 percent with sandstone more abundant than trachyte seem unlikely to be San Juan in origin, however). Franklin (1982) has created a category called "Cibola Carbon-on-white" for items that do not meet his criteria for either Chaco McElmo (his criteria are similar to those used by the Chaco Project) or for Mesa Verde Whiteware. The post A.D. 1100 assemblage from the nearby Bis sa'ani Community small sites is quite comparable to the upper Kiva 10 assemblage, and there is no doubt that some of the sand-and-sherd-tempered carbon-painted items classed as either "McElmo" or "Mesa Verde Carbon-on-white" in the bulk counts (Table MF-1.32) or as PII-III Carbon (this report, including Table MF-1.34) would fall into the Cibola Carbon group. As discussed below (Tables MF-1.33, MF-1.34) the redware in Kiva 10 is almost all White Mountain Redware or Tsegi Orangeware, and the polychromes are all from the Tusayan area.

The vessel form assemblages of the Kiva 10 stratigraphic sequence (Table MF-1.35) suggest that the bottom, mineral-paint-dominated layer shows the greatest affinity of the Kiva 10 units to the Trash Mound complex, but, again, they appear to be transitional. Only in this layer is the percentage of bowls less than 50 and the percentage of gray jars greater than 30; the frequency of closed whiteware forms is also high relative to all the other Kiva 10 levels except for Layer 2. Though all these relative frequencies are suggestive of the Trash Mound, none is as extreme as any of the Trash Mound booths, including even the earliest ones. Considering the high frequency of Chaco McElmo in Kiva 10 and the frequency of pitchers within that type, the percentages of pitchers are surprisingly low in all levels of Kiva 10. Because the levels containing larger quantities of Chaco McElmo also contain larger quantities of pitchers (Tables 1.34, MF-1.35), it is evident that higher pitcher frequencies relate more to Chaco McElmo than to the time period. The same could be said for the percentage of pitchers in Puerco and Gallup in the Trash Mound--in both the post-Red Mesa Trash Mound and Kiva 10, the percentage of pitchers runs from 2-7 percent, tending to be slightly higher in Kiva 10, and being highest in the Trash Mound in Booth 6, but never reaching the levels found within individual types.

Trends are also apparent in the Trash Mound to Kiva 10 temper distributions (Tables 1.32, 1.35, 1.36, and 1.37). The grayware counts by level in Kiva 10 are quite small, but the overall trachyte percentage is higher than that for Trash Mound Booths 3-6. Kiva 10, Levels 25-26, and Kiva 10, Layer 3, contain 64 and 80 percent trachyte-tempered grayware, respectively. As the percentage of grayware is considerably lower in Kiva 10, it appears that the difference in grayware use (and production?) is primarily a substantial reduction in sandstone-tempered jars, with trachyte import remaining at levels perhaps slightly less than in the preceding period.

Table 1.35. Temper frequencies by ware in Kiva 10 layers and levels and Kiva 16, Pueblo Alto.

	Layer 1	Level 17	Layer 2	Levels 20-22	Layer 3	Levels 25-26	Layer 4	Total	Kiva 16
Grayware									
Undifferentiated SS	1	4	8	5	3	8	14	43	37
More sherd than SS		2				2		4	2
Chalcedonic SS		2			2			4	4
Iron-bearing SS	1							1	
San Juan igneous	2	1		1				4	
Trachyte	7	13	3	5	18	17	4	67	26
with sandstone	1		2	1	2	1	4	11	4
sandstone dominant		1	1					2	
Totals	12	23	14	12	25	28	22	136	73
Mineral-on-white									
Undifferentiated SS	2	6	6	5	5	5	4	33	11
More sherd than SS	3	11	11	11	7	20	18	81	48
Chalcedonic SS			1	1	1		1	4	1
San Juan igneous						1		1	
with sandstone	1	1						2	1
sandstone dominant			1					1	2
Trachyte			2			1		3	3
with sandstone	3	3	2					8	12
sandstone dominant	1		1	2	1		1	6	18
Sandstone + Socorro			1		1			2	
Unidentified igneous	1	1		1		1	1	5	3
Totals	11	23	24	20	15	28	25	146	99
Carbon-on-white									
Undifferentiated SS	2	4	4	4	3	6		23	5
More sherd than SS	2	2	8	6	6	6	1	34	7
Tusayan SS		1		1				2	6
Sandstone > San Juan	1							1	1[a]
Trachyte	2	2	9	9	9	15	3	49	5
with sandstone	6	11	9	9	8	5	4	52	5
sandstone dominant	5	4	4	3	9	3	2	30	11
Unidentified igneous	2	5		1	1			9	5
Totals	20	29	34	33	36	38	10	200	45
All Wares									
Undifferentiated SS	5	16	18	17	13	23	20	112	55
More sherd than SS	9	22	24	24	25	44	28	176	70
Chalcedonic SS		2	1	1	3		1	8	5
Iron-bearing SS	1							1	
Tusayan SS		1		1				2	6
San Juan igneous	2	1		1		1		5	2
with sandstone	1	1						2	2
sandstone dominant	1	1						2	2
Trachyte	9	15	14	14	27	33	7	119	34
with sandstone	10	14	13	10	10	6	8	71	21
sandstone dominant	6	5	6	5	10	3	3	38	29
Sandstone + Socorro			1			1		2	
Unidentified igneous + SS	4	6		2	1	1	1	15	9
Totals	48	84	77	75	90	111	68	553	235

[a]San Juan > SS.

Table 1.36. Stratigraphic occurrence of trachyte in decorated whiteware.

	% trachyte-tempered c/w of all painted whiteware	% trachyte-tempered of all painted whiteware	Number of painted whiteware
Trash Mound			
B1	1.5	3	67
B2	5.7	20	35
B3	4.4	16	180
B4	6.0	23	215
B5	8.3	18	228
B6	4.5	25	179
Kiva 16	6.9	17.4	144
Kiva 10			
L4	20	20	35
25-6	30.3	31.8	66
L3	33.3	33.3	51
20-2	34.0	34.0	53
L2	31.0	37.9	58
17	25.0	26.9	52
L1	25.8	35.5	31

Trachyte and trachyte-more-abundant-than-sand are shown in this table, but sand-more-abundant-than-trachyte is not.

Table 1.37. Pueblo Alto temper types tabulated by identifiable vessel forms.[a]

Vessel Form	Undiff. Sandstone	Sherd> SS	Chalcedon. SS	Iron SS	Tusayan SS	San Juan Igneous	Socorro	Trachyte	SS> Trachyte	Unident. Igneous	Total
White bowl	246[b]	571	38	1	25	30	4	253	147	45	1,360
Ladle	28	62	5		1	3		46	14	7	166
Pitcher	27	39				3		22	22	5	118
Canteen	2	7				2		3	2		16
Seed jar	4	10	1			1		2	3	1	22
Tecomate	5	5						4	1		15
Cylinder jar		1									1
Olla	16	59				2		15	11	3	106
Whiteware jar	72	214	9	1		7	1	102	66	3	475
Mug	1										1
Duck pot	1	1									2
Miniature	1	4						4	2		11
Redware bowl	10	51				30				2	93
Smudged bowl	24	59								14	97
Redware jar		1				4					5
Grayware jar	487	39	81	20		15		701	5	3	1,351
Grayware pitcher	—	—	—	—	—	—	—	1	—	—	1
Totals	924[b]	1123	134	22	26	97	5	1,153	273	83	3,840
Percentage	24.1	29.2	3.5	0.6	0.7	2.5	0.1	30.0	7.1	2.2	

[a]Tempers have been lumped, and only items with observable temper are included.
[b]Includes one shale-tempered.

In the Trash Mound the small number of carbon-painted sherds are nearly 80 percent trachyte-tempered, whereas in Kiva 10 around 50 percent of the far more abundant carbon-painted sherds are trachyte-tempered.

Trachyte-tempered, mineral-on-white items form a much higher percentage in the Trash Mound than in Kiva 10. Thus, the portion of decorated whitewares (combining mineral- and carbon-painted whitewares, and excluding unpainted items) that is trachyte-tempered carbon-on-white is small in the Trash Mound booths (5-6 percent overall) and considerable in Kiva 10 (29.2 percent overall). The level of trachyte-tempered carbon-on-white to all decorated whiteware remains in the 4-8 percent range in the post-Red Mesa booths, is 20 percent in the mineral-dominated, earliest Layer 4 of Kiva 10, and then hovers around 30 percent in the remainder of Kiva 10. The addition of mineral-on-white, trachyte-tempered items changes the Kiva 10 percentages little, but raises the percentages in Trash Mound Booths 2-6 to around 20 percent. Therefore, the Chuska area does provide relatively more whiteware as well as grayware in the later periods, but, as in earlier periods, the within-ware trachyte percentages never reach the same levels in whiteware as they do in grayware, especially as the within-grayware levels show such a dramatic increase in later Kiva 10 (see also Figure 1.19, Table 1.33).

It has been noted that the last Trash Mound deposits show an increase in corrugated rim flare to a mean of 29°. The mean of the corrugated from the earliest Kiva 10 deposits is 35°, and of the more numerous ones immediately overlying them, 40°. The mean flares of values in Kiva 10 are erratic--the smallest value is in the highest deposit--but all are considerably greater than any in the Trash Mound (Table MF-1.35, Figure 1.20). The small mean for the uppermost layer may perhaps be explained by the likelihood of mixing in this rubble layer. Trachyte and trachyte-more-abundant-than-sand are shown in this table, but sand-more-abundant-than-trachyte is not.

Here again, it is seen that the earliest fill in the Kiva 10 sequence is the most similar to the Trash Mound, but is distinctive enough from the Trash Mound to suggest that it was not deposited contemporaneously with, or even directly following, the Booth 6 layers. The discrepancy may, of course, have more than a strictly temporal explanation. If we grant the multifaceted distinctiveness of the Trash Mound, the first trash deposits in Kiva 10 need not have resulted from similar activities as the deposits in the Trash Mound--the fact that one deposit is in a pitstructure and the other in a formal mound argues that they did not, which perhaps partly accounts for the reduced occurrence of grayware in Kiva 10. At the same time, the increase in carbons indicates that there is a temporal gap, at least in our excavated materials. That record suggests, then, a change of activity taking place in a relatively short time but leaving a short break. That gap could easily be filled by an as-yet unexcavated deposit at Pueblo Alto, but as it is not likely to be a Trash Mound deposit, its transitional nature may be more difficult to identify.

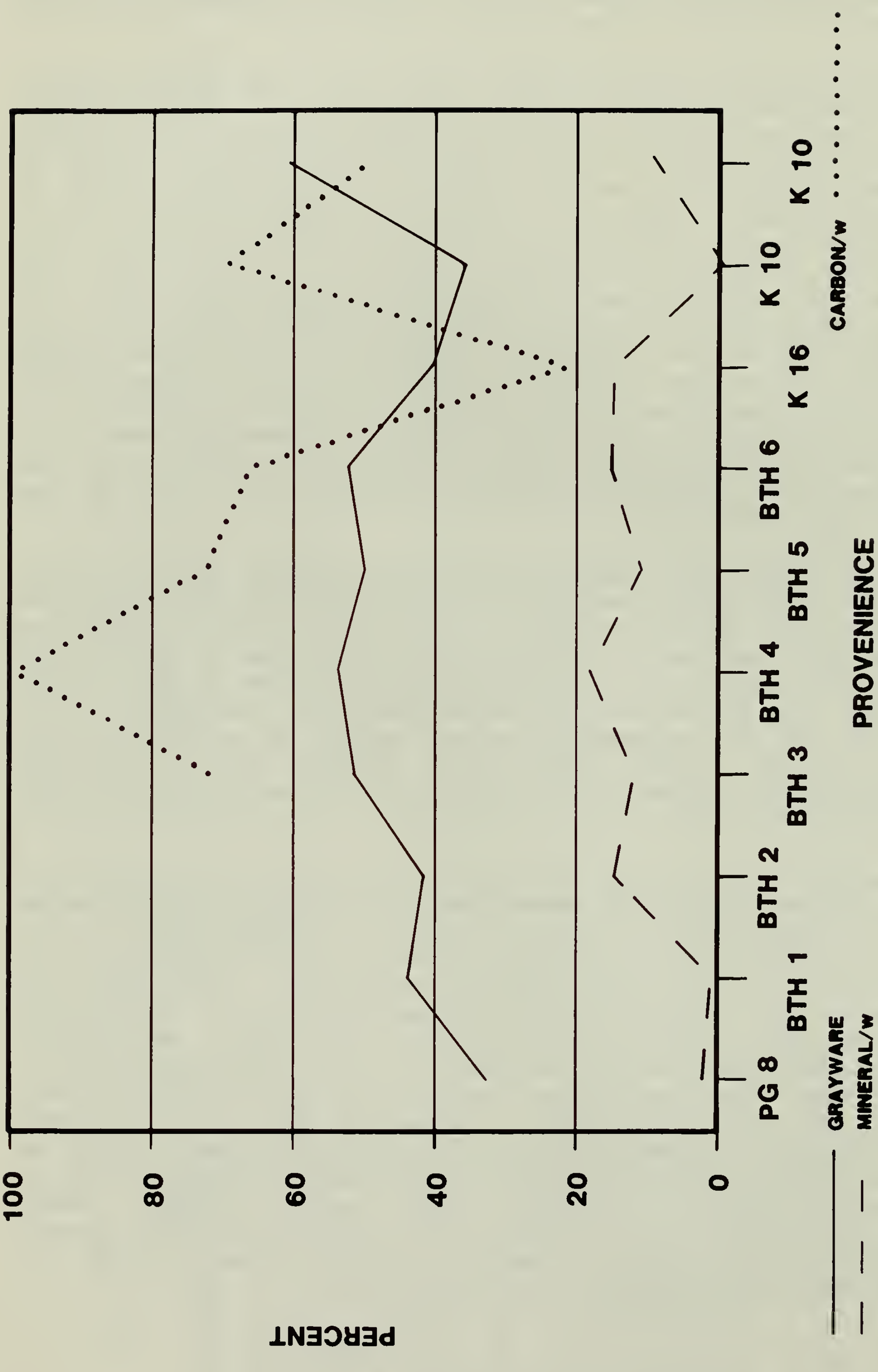

Figure 1.19. Trachyte temper relative frequency by ware by provenience.

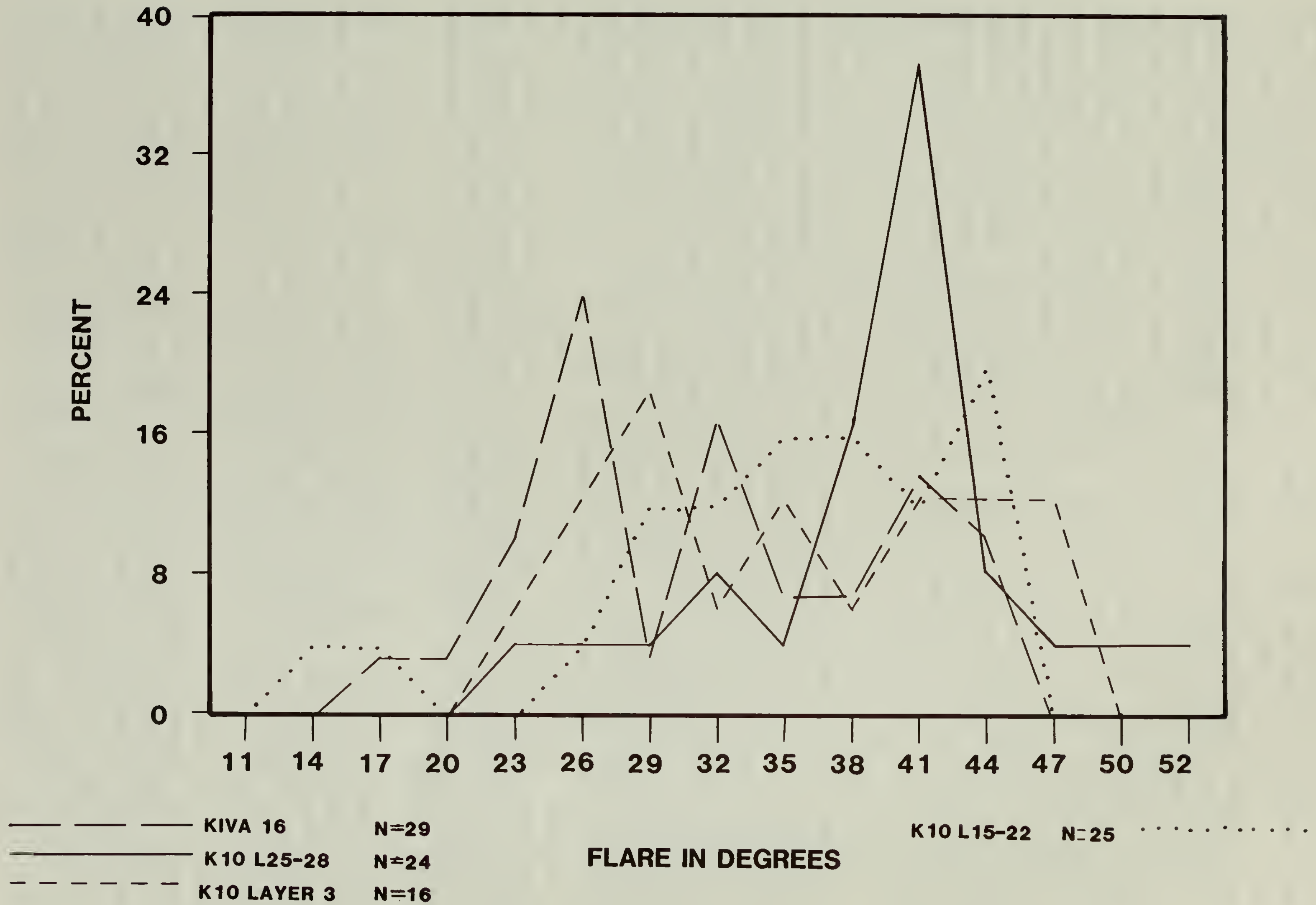

Figure 1.20. Grayware jar rim flare frequency in Kiva 16 and Kiva 10 levels.

Kiva 16--A Partial Link?

A small portion of just such a deposit may already exist in our own excavation sample. A series of trenches was dug in the area between the west wing of the Main Roomblock and the plaza rooms called Plaza Feature 1. These trenches encountered portions of two kivas, numbered 16 and 17. Kiva 16 contains dense trash deposits. Though the floor was never reached, the trench in the southern extreme of Kiva 16 provided a sizable ceramic collection, 236 sherds of which were drawn for the detailed analysis sample. The fact that the mean rim flare from Kiva 16 was intermediate to that for the Trash Mound booths and Kiva 10 prompted a closer examination of Kiva 16. The trench through Kiva 16 was excavated in arbitrary levels, three of which are represented in this sample. Little internal differentiation of the deposit was apparent in the stratigraphy (Schelberg field notes). A Chi-square test shows no significant difference in ware contents among the three levels, and the Kiva 16 deposit is therefore treated as a unit here. The data from Kiva 16 may be found on the Kiva 10 tables (1.33, 1.34, 1.35, and MF-1.35; see also Figure 1.20).

The type composition of the Kiva 16 sample places it quite clearly between the earliest Kiva 10 and latest Trash Mound deposits. Gallup is the most abundant mineral-on-white type, and mineral-painted whitewares constitute 28 percent of the total sample versus 19 percent carbon-painted. Within the carbon group the two most abundant types--Chaco McElmo and PII-III generic carbon-on-white--are absent in the booth sample (and rare in the whole Trash Mound sample), but Tusayan whiteware, occurring in later Trash Mound contexts but absent in Kiva 10, is also present in Kiva 16. White Mountain redwares are nearly absent from the Trash Mound booths, and San Juan redware is nearly absent from Kiva 10; Tsegi orangewares occur in both the later Trash Mound and Kiva 10. There are only six redware vessels represented in the Kiva 16 sample, but all three red series are represented (Table MF-1.33). Finally, the PII corrugated, which is far the most abundant corrugated type in the Trash Mound, is relatively scarce in Kiva 16 (more scarce, in fact, than in most Kiva 10 units), whereas PII-III and PIII items are similar in relative frequency in Kivas 10 and 16.

Of interest, then, is the degree to which distinctive aspects of the Trash Mound appear to be temporal and which behavioral, as it has been suggested above that the Trash Mound may represent, at least in part, deposits from special activities (as contrasted primarily with the small Kiva 13 sample, TS Group G, and with trash from other time periods in different contexts). The percentage of gray jars in the Kiva 16 form assemblage is 31 percent, that in Kiva 13 34 percent, and in the Trash Mound booths 43 percent. What this pleasantly serial set of figures could mean is that both time and practice are in operation and that, yet again, the Trash Mound is truly different (always, of course, keeping a cautious eye on the small samples). A series of ware and form tests comparing various stratigraphic combinations gives the impression that there are four discrete entities: Trash Mound Booth 6, Kiva 16, Kiva 10 Layer 4, and Kiva 10 above Layer 4, roughly in that chronological sequence. A

Chi-square test comparing the ware composition of Booth 6, Kiva 16, and Layer 4 of Kiva 10 indicates that the three are different, largely because of the high gray frequency in the booth and the occurrence of carbons in Kiva 16 (Table 1.33).

That Kiva 16 deviates most strongly from expected in carbons at first seems to contradict its predating Kiva 10 Layer 4, but it should be remembered that many of the carbons in Kiva 16 are Chaco McElmo and Tusayan, which are "early late" carbons. With the samples available it cannot be stated with confidence that these two deposits have been correctly placed; the contiguity of the basal Kiva 10 layer with clearly later deposits suggests that it may postdate Kiva 16, though not by much. Kiva 10, Layer 4, is significantly different from the overlying layers; Kiva 16 also differs from the upper Kiva 10 layers, but the latter do not differ among themselves. The forms from the three transitional deposits reflect the ware comparison--Booth 6 has fewer than expected bowls and more than expected gray jars, whereas both kivas are the converse. Booth 6 is significantly different from the kivas in temper as well--as noted, both of the other deposits have an "anomalously" low trachyte frequency in graywares.

The percentage of bowls of all wares not surprisingly forms a sequence in the reverse of gray jars: the Trash Mound booths (29.8 percent), Kiva 13 (45.1 percent), Kiva 16 (41.1 percent), Kiva 10 Layer 4 (47.1 percent), and above Layer 4 in Kiva 10 (57.3 percent). Closed whiteware forms are about 20-22 percent in the Trash Mound, Kiva 13, and Kiva 16, but 16 percent in Kiva 10, Layer 4, and 12.5 percent in upper Kiva 10. Granted, these sequences do deal in percentages, which must form complements; the presence of multiple other forms and the consistency with which they work in the time sequence, however, gives them considerable credence.

The temper assemblage in Kiva 16 is in some respects transitional between late Trash Mound and Kiva 10 and, in others somewhat anomalous. Trachyte-tempered grayware is relatively infrequent (41.1 percent of the grayware) as compared with either of the other two deposits. As sandstone is the majority temper, the Kiva 16 complex is most different from the later Kiva 10 layers. Though the samples are small, it is notable that the grayware in the bottom layer of Kiva 10 is quite similar to that from Kiva 16 in that it, too, has more sandstone than trachyte temper. In the mineral-painted wares, Kiva 16 has the highest percentage of trachyte (15.2 percent) of the three lumped proveniences, though Booths 4 and 6 are slightly higher (18.7 and 15.6 percent) and post-Red Mesa booths about the same (14.5 percent).

The carbon-on-white tempers are perhaps the most anomalous--as noted above, in Kiva 10, Layer 4, and the later booths, the carbons are heavily trachyte-tempered, whereas in Kiva 16 trachyte is only 22 percent of the carbon-on-white temper (Tables 1.32, 1.33, and 1.35). This is attributable to three things: (1) the higher frequency of more sandstone than trachyte items, which is, in turn, most likely a result of the high frequency of Chaco McElmo in Kiva 16; (2) the relative importance of Tusayan

whiteware in Kiva 16; and (3) the dominant Carbon-on-white in Kiva 16 being "PII-III Carbon-on-white," probably including "Cibola Carbon," which contributes the sandstone and sherd tempers less common in the Trash Mound carbons.

The relative placement of lower Kiva 10 and the fill of Kiva 16, therefore, remain somewhat unclear--they are quite similar, but just different enough that they do not seem exactly contemporaneous. Windes placed lower Kiva 10 in the A.D. 1020-1120 time group and Kiva 16 in A.D. 1120-1220, and there is some reason to believe his ordering is correct, though the date labels are somewhat misleading in this case. Very high percentages of trachyte in carbons seem to be earlier patterns (see Table MF-1.32, Figure 1.19), and the overall frequency of carbon-painted sherds is less in lower Kiva 10 than in Kiva 16. On the other hand, the lower frequency of trachyte in mineral-on-white in Kiva 10, Layer 4, is more reminiscent of later Kiva 10 than the Trash Mound, while the reverse is true in Kiva 16. Thus, although Kiva 16 may last longer, it seems likely that the two deposits overlap in time.

Redware Distribution

As noted in the Sample and Analysis section, the types used for the detailed analysis are on a rough-sort level for uncommon types. This causes difficulties in exotic wares, in particular, as assignment to at least the series level carries considerable source information. The problem is somewhat acute in the redwares, and is exacerbated by confusions within the redware typology itself, and even further by the use of multiple tallies. McKenna sorted the bulk ceramics and identified to the detailed, type level carbon, polished smudged, and redwares; Windes then used those counts in the compilation of the bulk count by provenience tables for Pueblo Alto (Appendix MF-E in Volume II of this report) and attempted to reconcile the two counts where they did not match. A summary of Windes' tables appears in Table MF-1.33 and presents the types as assigned; Table MF-1.34 contains final analysis counts for redwares by provenience and temper.

The typological and source pictures for the San Juan Redwares are both convoluted and vague. Type names have been changed and the assumption made that the taxonomic name or the location of recovery somehow reflect the place of manufacture within this series (creating a classic instance of the typological tail wagging the ceramic dog). Lucius and Breternitz (1981) summarize the history of the series in more depth, but it is recapitulated here in the context of its effect on the present analysis. Several workers have classified types as San Juan Redwares. The type of most temporal relevance to Pueblo Alto and of greatest confusion is Deadmans Black-on-red. Abel (1955) defined a type for the Mesa Verde area which he called La Plata Black-on-red; Breternitz et al. (1974) later used a similar description for a type they called Deadmans, based on the fact that they felt Colton had described the type in 1932 (see Colton 1956:Ware 5A Type 6). Colton attributes the type to an area in northeastern Arizona entirely south of the San Juan River with a southern limit at

the Little Colorado River. This area is subsumed by the Tsegi Orange Ware area shown in the same volume.

In spite of the locations that he gave them, in 1956 Colton placed Deadmans and a related type, Middleton Black-on-red, in the "San Juan Red Ware, Little Colorado Series," but in Colton (1965) the types were listed in the "Tsegi Orange Ware, Little Colorado Series." Colton's 1956 definition specifies the temper of Deadmans as "rock (test by Shepard), angular quartz, lesser amounts of hornblende (?), or basalt (?)" and dates it at A.D. 750-1050. Abel (1955:Ware 5A Type 5) defines La Plata Black-on-red, an andesite-tempered, slipped redware, dating to A.D. 800-1000 and attributed to southeastern Utah on both sides of the San Juan River; this is the type that was renamed Deadmans in 1964. Hayes and Lancaster (1975: 137) and Breternitz et al. (1974) outline the decisions made at the 1964 Museum of Northern Arizona ceramics conference, where a number of pre-existing redware types, including Deadmans and La Plata Black-on-red, were collapsed into a single type. They note a "La Plata variety" of Deadmans, which is slipped and less common than the unslipped variety. Deadmans, in general, was found stratigraphically to be "entirely a Pueblo II type" of uncertain terminal date. Lucius and Breternitz (1981) retain the Deadmans name and suggest a terminal production date between A.D. 950 and A.D. 1000, at least for the Dolores Valley area.

A final ironic terminological twist is that, though the exact location of San Juan Redware manufacture is not known (Breternitz 1982:132-134), there is good reason to suspect that it was made in southeastern Utah, in the Blanding-Bluff area (Lucius and Breternitz 1981:106). While Bluff is on the San Juan River, Blanding is well removed; moreover, there is an unspoken but nonetheless real archeological association of "San Juan" with the major Anasazi population in the Aztec/Salmon/La Plata area of the San Juan and its tributaries. There is currently little speculation that San Juan Redwares were manufactured in that area.

It is, therefore, easy to understand how in 1979-80, when McKenna typed the Pueblo Alto sherds, there was considerable unresolved confusion about the name Deadmans. Lucius and Breternitz (1981) do not address the problem, created in part by Breternitz et al. (1974) and not addressed therein, either. Based on temper, one must assume that there is one type meeting this description and that it is a San Juan Redware. Presumably, the redwares meeting this description and found in northeastern Arizona--and in Chaco Canyon--are also San Juan Redware, which is consistent with our understanding and identification of the tempers. We had no basis for attributing any crushed andesite/diorite temper to Arizona. Further, one suspects that "Middleton Black-on-red" (Colton 1956:Ware 5A Type 8)--a hachured, rock-tempered, slipped redware called a variety of Deadmans, attributed to the Virgin Branch, and apparently rare (based on the few illustrated)--may also be a southeastern Utah/San Juan product. Breternitz et al. (1974:62) make the statement that their Deadmans "is most difficult to distinguish from Middleton Black-on-red, a type which does not normally occur in Mesa Verde"; they also picture a hachured Deadmans

bowl. Plog (1980b) emphasizes the fact that San Juan Redwares are a major import to Black Mesa, which lends further support to the idea that the San Juan is the most reasonable source for this elusive type. The Tsegi Orange Wares are all listed by Colton (1956:Ware 5B) as having sand and sherd tempers.

As can be seen in Table MF-1.33, McKenna used both the type names La Plata and Deadmans Black-on-red in tabulating the bulk sherds from Pueblo Alto. The definitional basis for separating the two comes from the confusing descriptions outlined above and from discussions with Hayes. The distinction is primarily one of slip color and paint:

> Deadmans is distinguished on the basis of the presence of white rock fragments lacing black particles in sherds with purplish paint and an orange (or no?) slip; Hayes and Lancaster (1975) discuss the apparent areal variation of paint; McKenna and Windes sometimes referred to this variant as "Arizona Deadmans."
>
> La Plata is characterized by black fragments and pyroxene crystals in association with white rock temper in sherds with redder slip.

Following Warren (1977), the final temper analysis made a distinction between andesite/diorite with and without hornblende (which shows as black specks). The presence-absence of hornblende may well carry a source relationship but it is at this time unknown, especially since andesite/diorite is widely distributed in the northern tributaries of the San Juan; the presence of hornblende is regarded here as a variant of the same rock. The same is true for pyroxene, though its abundance in sherds is considerably less than hornblende in my experience.

Shepard (1939:270-272), in what is probably still the best published description of redware pastes, demonstrates that there is variability in "Pueblo I Black-on-red" sherds, but the temper attributes cited do not coincide with those used by McKenna. In retrospect, McKenna feels that the Deadmans-La Plata distinction is a dubious one and that it may not have been consistently applied. Plog (1980b) discusses what he calls the local assumption--the idea that the great majority of pottery was made where it was found; this redware dilemma is a striking example of the effects of that assumption and of moving away from it. The temper of the types in question makes a reasonably strong case for manufacture in the northern San Juan drainage, but under the local assumption the presence of the ware in northeastern Arizona was sufficient to attribute the pottery to northeastern Arizona. Now that archaeologists believe in extensive exchange of substantial quantities of pottery, it seems reasonable to suggest that Colton's perceived types came from an entirely different area from that to which he attributed them. All in all, then, it seems most reasonable to regard Deadmans as a San Juan ware from the San Juan region as specified by Lucius and Breternitz (1981:100), which is equivalent to the type formerly called La Plata Black-on-red. The most important points to be gained from this typological discussion are first, that there is variability within this technological/stylistic category, probably indicating a number of producers; second, that San Juan Redwares were very

widely circulated in the greater Four Corners area; and, third, that the area of production presently seems most likely to be southeastern Utah north of the San Juan River.

Combining San Juan and Deadmans from the bulk counts (Table MF-1.33), we can see that over 90 percent of all the proveniences predating Trash Mound Booth 6 are in that group; the final-analysis sample shows no non-San Juan tempers in redwares from the same proveniences. Identification of series from temper alone becomes more difficult in the later proveniences because at that time (ca. A.D. 1100) Tsegi Orange and White Mountain Red Wares became dominant, and both contain combinations of sand and sherd temper. White Mountain Redware paste is distinctive in its superabundance of sherd temper and the color of both the clay and the temper, but that distinction is not always visible in the coding. Items with more sand than sherd temper are likely to be Tsegi, and those with nearly all sherd temper and the paste type "black and white sherd temper" are likely to be White Mountain. The bulk counts suggest that San Juan Redware constitutes 44 percent and Tsegi and White Mountain each 28 percent of the total redwares, though the 121 Tsegi sherds from Room 103 are probably nearly all from one Tusayan Black-on-red jar. The final analysis shows 61 percent sand and sherd-tempered members, not far different from the 56 percent of the bulk count (only 50 percent, counting the Room 103 jar as one sherd). In the final analysis, these come from the west rooms, Kivas 13, 16, and primarily Kiva 10. The relevant sherd-tempered redwares all are dated post-A.D. 1050 except Puerco Black-on-red at A.D. 1000 (Breternitz 1966; Carlson 1970; Colton 1956) (see Table MF-1.33).

The possibility remains that McKenna's "Arizona Deadmans" group has some significance. The ratio of McKenna and Windes' Deadmans to San Juan (Bluff, La Plata, and untyped San Juan Redware combined) is .49 (143:294) in the bulk counts, whereas the final-analysis ratio of no-hornblende to hornblende-present redware is .38 (10:26), suggesting a similarity of observation. However, an equally logical comparison of McKenna's Deadmans: La Plata gives a ratio of 2.51 (143:57) for which no parallel can be found in the final analysis.

If one concludes that "Arizona Deadmans" is a San Juan Redware, another problem presents itself--the San Juan tempers predominate in redwares in proveniences thought to postdate A.D. 1000 by around 100 years. Breternitz (1966:73) places "trade" dates at A.D. 850-1130 for Deadmans (A.D. 775-1150 "indigenous") and "best" at A.D. 850-900 for La Plata (1966:81). Presumably, this is further evidence of typological uncertainty, but it may well be that terminal dates of A.D. 1000 are too early for San Juan Redware. Granted, it is an "exotic" to Chaco Canyon and some treatment of such vessels as heirlooms would be expected, but it is truly striking that other wares--Puerco and Tusayan Black-on-red, the best two examples--are virtually absent in contexts that should fall within their time of production, whereas San Juan sherds persist well after their putative cessation of manufacture.

Although there are some San Juan sherds in the later deposits--presumably the results of mixture, recycling, and long use of vessels--the shift to dominance of the other wares appears to be relatively quick (the Kiva 16-basal Kiva 10 deposits). This apparent disjuncture suggests that the change in redwares supply came late. San Juan Redwares seem to show up regularly in later proveniences throughout the Anasazi area (dates in Breternitz 1966 and Colton 1956); perhaps after a period of marked popularity in the north (see Hayes and Lancaster 1975:138), production greatly decreased but did not stop. It is impossible to disagree with Lucius and Breternitz, Hayes and Lancaster, and Shepard that the redwares could use further study.

Polished Smudged Ware Distribution

The subdivision of polished smudged wares on traditional typological lines is more difficult for carbon and redwares, and, once done, has less extensive implications than do the other low-frequency wares. It is our assumption that polished smudged wares other than Lino Smudged come mostly from the vicinity of the Mogollon Rim in east-central Arizona. Using refiring tests, McKenna has noted some shifts in clay type in smudged wares found in Chaco Canyon; he suggests that the buff oxidizing clays from later contexts could represent manufacture closer to Chaco. The smudged wares may be divided into four meaningful groups in Chaco--Lino Smudged, Woodruff Red, Forestdale Smudged (and varieties), and Showlow Smudged. Such types as Lino, Woodruff, Forestdale Smudged and affinis indented corrugateds are relatively well known (Connally 1940; Haury 1940; Mera 1934:12), and commonly identified intrusives in Anasazi assemblages. The one type not commonly identified, however, is Showlow Smudged (Colton and Hargrave 1936:78; Mera 1934:12) which we have given priority over the more commonly recognized Reserve Series. Mera's emphasis on the slipped high gloss finish of Showlow dovetails with our own study which also shows the use of sherd temper in a white firing clay body that required slipping to achieve the red exterior (Toll and McKenna 1980). Although there appears to be a transition from refiring to white firing clays, the use of slip, sherd temper, and the high quality of surface finish differentiate Showlow from the Reserve Series which remain, essentially, a sand tempered Mogollon brownware exhibiting plain finishes less glossy than Showlow (see Nesbitt 1938).

Woodruff and Lino, early types, are rare and absent, respectively, at Pueblo Alto. About 80 percent of the typed smudged ware in Pueblo Alto bulk sherd counts is Forestdale, nearly 90 percent if corrugated and other variants are included (Table MF-1.36). It was found in all the proveniences containing smudged wares except for the East Ruin. The fourth polished smudged category is Showlow Smudged, distinguished from Forestdale by the presence of obvious slipping and more abundant sherd temper--this paste resembles that of some Little Colorado Whitewares. The distribution of Showlow Smudged in the bulk counts is quite well defined temporally--it was recovered from Trash Mound Booths 5 and 6 and Kivas 13 and 16. Its distribution is, thus, most similar to that of Tusayan Whitewares

and may be placed in the late A.D. 1000s to early A.D. 1100s at Pueblo Alto. Only in Kiva 13 is the bulk count of Showlow greater than that for Forestdale. In McKenna's estimation "Winona Smudged" is largely a terminological artifact; if present in Chaco Canyon, it may be a better polished and slipped version of Showlow; the only occurrences of Winona are in proveniences containing Showlow. There is supposed to be a tempering difference between Winona and Showlow Smudged--the presence of black sand --but this is either difficult to detect or rare or both.

The temper-paste attributes recorded in the detailed analysis do not redefine the Showlow-Forestdale split. There is a substantially increased frequency of sherds with temper identified as sandstone-igneous mix in the proveniences that contain more Showlow Smudged in the bulk counts (Table MF-1.36). The temper elements leading to an igneous code are hornblende, biotite, and what appears to be crushed rock. This temper identification is also present in other temporal contexts. All but three of the smudged wares in the detailed analysis have some sherd temper, but there is considerable variability in quantity, even among sherds that are nominally Forestdale. Sherd temper tends to be white, but other shades were also observed. Pastes are also variable, with tan to dark brown the most common, but with black and gray also occurring. Warren (1976, 1977) has noted colored quartz (?) grains in polished smudged ceramics; a tally separate from the coding shows grains--usually pink and yellow--in one-fourth (25) of the analyzed sherds. Occurring in similar frequencies, sometimes with colored grains, sometimes not, are small, black, shiny specks. As is also true for the redwares, Kiva 10 has a high percentage of polished smudged vessels in its fill, including, interestingly enough, only one Showlow Smudged sherd but the great majority of Forestdale Corrugated from the site.

Internal Analysis Summary and Synthesis

A synthetic picture of ceramic use, disposal, and import at Pueblo Alto can be drawn so long as it is recognized at the outset that some of the time segments on which it is based have very small samples. In the earliest known Pueblo Alto occupation the pattern is one familiar from Red Mesa portions of 29SJ 629, 29SJ 627, and 29SJ 1360. Whitewares are predominantly bowls and the majority contains sandstone and sherd temper, usually with more sherd than sandstone. Graywares constitute less than half of the vessel assemblage, and although trachyte temper is found in over one-third of the grayware, sandstone is also the predominant temper here. Trachyte is rare in whitewares, but is the temper of most of the scarce, carbon-painted vessels. Toward the end of the Red Mesa period chalcedonic sandstone temper is at its most abundant, but it is never as common at Pueblo Alto as it is at the smaller sites in the canyon.

As Gallup and Puerco replaced Red Mesa, the use of the Trash Mound for nonconstructional debris commenced, and trachyte temper became more abundant in both white and gray wares, constituting around half of the graywares. At Pueblo Alto trachyte-tempered mineral-on-white is more

abundant than all carbon-on-white during this period of peak deposition, and the majority of the carbon-on-white remain trachyte-tempered. Between carbon- and mineral-painted items, trachyte is the temper of one-fourth to one-fifth of the whitewares. Up to and through the use of the Trash Mound, redwares are nearly all from the San Juan series--White Mountain Red and Tsegi Orangeware sherds are scarce in the Trash Mound, and Chuska redwares are virtually absent.

The Trash Mound stands out from all other deposits--even those thought to be contemporaneous with it--in its high percentage of grayware jars. Closed forms of whiteware increased from earlier periods, but this phenomenon was not restricted to the Trash Mound and appeared to continue after the mound had fallen into disuse. Both of these increases in percentages were complemented by a reduction in the percentages of bowls; redware and polished smudged bowls tended to occur at similar, low-level frequencies in Red Mesa contexts, so that the severe reduction was in whiteware bowls. Perhaps some compensation for this was made by making somewhat larger bowls; however, it seems most likely that this vessel form shift relates to shifts in ceramic usage, presumably through the addition of a new set of activities.

Two deposits from the period immediately following the use of the Trash Mound--Kiva 16 and the lower levels of Kiva 10--suggest what may have occurred ceramically after the cessation of Trash Mound deposition, an event that seems to signal a shift of behavior at Pueblo Alto. The most obvious ceramic change at this time was an increase in the use of carbon paint on whitewares, though the deposits from this period immediately following the Trash Mound contain more mineral-on-white than carbon. Kiva 10, Layer 4, continued the earlier pattern of predominantly Chuskan carbons whereas Kiva 16 exhibited the substantial quantities of carbons with other tempers seen in later, carbon-dominated deposits. High percentages of mineral-painted, trachyte-tempered ceramics are present in the Trash Mound and show no decline in Kiva 16 but thereafter become infrequent.

Also at about this time--toward the end of the Trash Mound deposition, extending into Kiva 16--there seems to have been the greatest emphasis on ceramics typologically from northeastern Arizona. The bulk counts for both Tsegi Orangeware and Tusayan Whitewares show their highest percentages in Kiva 16. At Pueblo Alto this influx of ceramics from that area does not appear to have been simultaneous for the white and the red pottery. Tusayan Carbon-on-white shows a sudden increase in the latter part of the Trash Mound (Booths 5-6), is present at the same relatively high levels in Kiva 16, and declines in Kiva 10. Tsegi Orangeware makes an appearance in the late Trash Mound sequence but in Kiva 16 is 68 percent of the "redware." Plog (1986:293) shows a remarkably similar change-over from San Juan Redware dominance to Tsegi Orangeware dominance at around A.D. 1075 in Black Mesa samples, reemphasizing the regional nature of redware supply. The Tsegi portion of redwares remains high in Kiva 10, but most of the redware in Kiva 10 is White Mountain. The tempers in the final-analysis sample echo the bulk counts except that the Tsegi Orangeware percentage appears somewhat inflated.

Curiously, both Kiva 16 and Kiva 10, Layer 4, suggest a dip in the percentage of trachyte-tempered graywares, concurrent with a reduced percentage of graywares overall. Because the percentage of graywares declined further in the time following, but with an increase to new high percentages of grayware with trachyte temper, it may be that this blip in an otherwise regular trend signifies a perturbation in the supply system. That is, there seem to be multiple adjustments that were necessary at this time:

--a change in the system such that Trash-Mound-related activities ceased, apparently reducing the need for gray jars.

--a change in production such that carbon paint came to be the primary pigment. There is evidence to suggest that this was a shift within previous mineral traditions--the Cibola and the San Juan--as well as a shift in emphasis on import of the long-standing Chuska carbon tradition. There are concomitant design shifts. The correlation of social with ceramic change is a subject of debate (Foster 1965; Snow 1982; Tschopik 1950), but other evidence here is that a change was taking place and that these ceramic changes were contemporaneous if not consequent. Adams (1981:329-332) argues that rapid shifts in Hopi ceramics can be correlated with periods of stress, relocation, and contact with other groups.

--a change in redware supply. The San Juan redware series persists in the Trash Mound (presumably until at least A.D. 1100) even though it is thought to have gone out of production around A.D. 1000, at least in the Dolores/Mesa Verde area (Lucius and Breternitz 1980). The constant percentage of both red and polished smudged bowls through time is remarkable and strongly suggests that an effort was made to keep a few such vessels in the functioning ceramic assemblage. After the brief period of high-frequency Tsegi Orangeware noted above, White Mountain Redware takes the place of San Juan Redware in the Pueblo Alto assemblage, though later than would be expected, and also at this time of social and ceramic change.

Following this somewhat speculative period of disturbance in ceramic supply and lasting through the end of the excavated record in our possession, a pattern that is in some ways new and in others familiar is present. The most apparent new aspect is that carbon paint has become more common than mineral paint on whitewares, though mineral-on-white wares are still common. Some of the mineral-on-white ceramics in these late deposits are surely a mix, and some are the result of long-used vessels finding their way into the trash many years after they were produced. It seems likely, though, that some mineral-painted whiteware was still being produced--the move to carbon-on-white does not have the appearance of a region-wide decision, but of a marked, though incomplete, shift. The vessel form assemblage, on the other hand, is more familiar--the assemblage at 29SJ 627 and 29SJ 629 is not radically different, though whiteware closed forms are more common in the late Pueblo Alto deposits. The higher percentage of bowls and the lower percentage of gray jars are a change from the middle assemblage. The new, high frequencies of both trachyte temper and sooting relative to other deposits may indicate the loss of some sandstone-tempered culinary producers and either removal of some grayware functions or multiple uses of the fewer gray pots present.

Finally, there are some important typological absences at Pueblo Alto vis-a-vis dating both site and ceramics. Both St. Johns Polychrome and Mesa Verde Black-on-white are considered hallmarks of the thirteenth century and both are absent at Pueblo Alto. All four "Mesa Verde Black-on-white" items in the analysis (three from Kiva 10) are trachyte-tempered and, thus, technically "Crumbled House Black-on-white" (Plate 1.8b; Windes 1977); their appearance here in the absence of San Juan Mesa Verde Black-on-white is interesting with respect to where this distinctive style may first have appeared. Franklin (1982:33,56) also reports more Crumbled House than Mesa Verde for the Bis sa'ani community small sites and assigns Crumbled House a starting date of A.D. 1150, 50 years earlier than Mesa Verde (following Windes 1977). With some ambivalence, Windes and McKenna typed the whole vessel shown in Plate 1.8b as Mesa Verde Black-on-white--it could also be considered Nava Black-on-white (the paste, temper, paint, and slip all fall well within the Chuskan norm). This ambivalent assignment suggests that this vessel may be an early example of Crumbled House Black-on-white.

Time Group Reassessment

This extensive examination of deposits and use of time groups allows a reassessment of the date labels assigned to segments and to time-space groups. The dates shown below are the result of relative deposit-placement and ceramic dates rather than the incorporation of massive new chronometric information.

Plaza Grid 8, Time Group A.D. 920-1020

This time group is intended to designate an all-Red-Mesa assemblage, which is accurate for this deposit. In view of the scarcity of earlier types, including "Early Red Mesa," the beginning date is probably early for this deposit, but the assignment of an actual new date is not warranted.

Early Trash Mound, Time Groups A.D. 920-1020 and A.D. 1020-1040

The time placements are somewhat jumbled, as discussed, but were intended to indicate transition from a Red-Mesa-neckbanded assemblage to a Gallup-indented-corrugated assemblage. Such transitional assemblages are characterized by a mixture of Red Mesa and early Gallup. Given the lack of Early Red Mesa and the dates known from the site, A.D. 920 is probably a good deal too early--it is not feasible to place this deposit relative to that in Plaza Grid 8, but clearly, this one continues and may thus be later. Perhaps the most reasonable way to view the early Trash Mound is as one deposit, dating something like A.D. 1000-1040, which could be subdivided into A.D. 1000-1020 and A.D. 1020-1040.

Main Trash Mound, Time Group A.D. 1020-1120

In essence, this is a Gallup-Puerco-dominated assemblage, lacking Chaco McElmo. Because of the absence of Red Mesa on one end and Chaco McElmo on the other, this group should probably be truncated to A.D. 1040-1100. Some of the room deposits and the Kiva 13 sherds seem to fit with this deposit.

Degraded Trash Mound, Time Group A.D. 1020-1220

This group includes washed and somewhat mixed "terminal" layers of the Trash Mound. Its later date results from the presence of a few later carbons, but A.D. 1220 is clearly very much too late--the majority of the deposit undoubtedly derives from the A.D. 1040-1100 main Trash Mound, with some from the earlier part as well. A safe, new estimate is A.D. 1020-1130.

Kiva 10, Layer 4, Time Group A.D. 1020-1120

This deposit seems to be contemporary with the end of the Trash Mound plus a few years, so a date of A.D. 1090-1120, or perhaps A.D. 1110, seems reasonable, if speculative.

Kiva 16, Time Group A.D. 1120-1220

As discussed, this deposit seems to substantially overlap with Kiva 10 Layer 4; thus A.D. 1090-1130 is a safe guess, though there is an inclination toward A.D. 1100-1120.

Upper Kiva 10, Time Group A.D. 1120-1220

There is a capping archeomagnetic estimate of A.D. 1210 for this deposit; its beginning date is clearly contingent on the end date for Layer 4. The primary characteristics of such deposits are more carbon than mineral-on-white, an increase in grayware rim flare, and predominance of White Mountain in the redware. St. Johns Polychrome (a White Mountain Redware) is absent, indicating a pre-thirteenth century date. The absence of Mesa Verde Black-on-white and the presence of Crumbled House lead to an estimate of A.D. 1120-1170. It is quite unlikely that this deposit extends into the thirteenth century, but it may postdate A.D. 1170.

Again, the dates are informed guesses, but the sherd groups should have broader applicability.

Technological and Functional Attributes

Vessel Form Co-occurrences

In addition to the source information contained in temper types, temper type, size, and quantity have functional implications. Fundamentally, a dichotomy is possible--cooking and/or utility wares generally require coarser and more abundant temper, whereas well-finished "service" vessels tend to finer temper and texture. There are, of course, exceptions and subvariations in time, source, and within-ware function. Viewing the form by temper table (Table 1.37, which does not take into account density or size of temper) shows that the temper types recorded can be dichotomized in the same way--that is, some of the tempers tend to be found in gray wares and some in white wares. Over half of each of the categories' "undifferentiated sandstone," chalcedonic sandstone, trachyte (which here includes trachyte only and trachyte plus sand with trachyte dominant), and iron-bearing sandstone (mostly magnetitic sandstone) is found in gray jars. Both the sherd-dominated sandstone and sand-dominated trachyte temper groups, on the other hand, have more than half bowls and much higher percentages of whiteware jars.

The vessel form distributions of sherd-dominated sandstone and sand-dominated trachyte are remarkably similar, as are those of chalcedonic sandstone and trachyte. This information seems to be primarily source-related--that is, the "grayware tempers" are all nonlocal. From their frequency it is evident, then, that gray jars from these areas were found to be satisfactory, but the degree to which these particular tempers were functionally preferable is difficult to determine. At both this site (see below) and others (Toll 1984) little association between sooting and temper has been found, which leaves the question unanswered. A corollary to the ware-temper association is that the sandstone-trachyte-mix vessel assemblage conforms better to the sherd-tempered assemblage (these two groups, at least in part, are the most local, and some of the trachyte is likely to have come from sherd temper) than to the trachyte assemblage. Because the trachyte assemblage also contains all the primary whiteware forms, the temper-ware dichotomy is obviously not a complete one.

Excluding gray jars and redwares, the whiteware forms found within temper groups are quite similar--San Juan, sandstone, and chalcedonic sandstone have relative bowl frequencies of over 60 percent, differentiating these three groups from the sherd, trachyte, and sandstone-trachyte groups that have somewhat lower bowl frequencies and higher jar frequencies. Although there are no glaring differences among the four largest temper groups within the whitewares, there are enough differences to generate a Chi-square significant at .05 (Table MF-1.37). The larger differences contributing to this result are more than the expected number of ladles with trachyte and undifferentiated sandstone temper, more sandstone-trachyte than expected in both special closed forms (pitchers, canteens, seed jars, tecomates) and jars and ollas, and less sandstone in closed forms.

Vessel form-paint associations reflect to some degree vessel form-temper associations because of the strong carbon paint-trachyte connection (Tables MF-1.37, MF-1.38). Thus, carbon paint is found on a relatively large number of ladles and on relatively few closed forms in the A.D. 1020-1120 time group. In the A.D. 1120-1220 segment, carbon paint shows a reduction in the ladle percentage and a very high bowl percentage (76 percent). In the A.D. 1120-1220 time segment, the low frequency of closed forms with carbon paint continues in spite of the fact that over half of the whitewares in this segment are carbon-painted; all the carbon-painted "special closed forms" falling in this time segment are pitchers. Closed forms are provided mostly by the two, primary, mineral paint types, black and brown--both groups show high relative frequencies of jars and ollas, and the unusually large, brown paint group contains several special forms as well as the highest within-paint percentage of ladles. As discussed in the Type-Temper-Surface Combination section, there is some likelihood that mineral-paint-color variation has source significance.

By far the most abundant mineral paint color is black--only in the large A.D. 1020-1120 group can colors other than just black and brown be tested. A significant association between lumped forms and mineral paint types is present--both brown and green paint are found disproportionately on ladles. The paint type deviating most markedly from the expected is "glaze," which is here heavily associated with closed forms. It has the highest within-paint percentages of pitchers, ollas, and white jars and the lowest of bowls. This does not accord with the finding at 29SJ 627 where this paint variety followed the expected form distribution. Although little difference is found in form distribution between brown and black paint within time segments, a significant shift toward higher percentages of brown paint is visible through time (Table MF-1.37).

As has been true at other sites, the temper-grain size of graywares is a mirror image of that of whitewares (Table MF-1.39). This opposition clearly has some functional correlates, but a similar carryover into whiteware function is not clear. As whitewares contain considerably more sherd temper--the particle size of which was not recorded--the grain size information is somewhat imprecise. Specialized, closed, whiteware forms tend to have finer tempers whereas ladles and ollas do not. The peak percentage of coarse--very coarse tempers found in ladles (19.3 percent) is harder to rationalize than the higher-than-average percentage found in ollas (16 percent), which share size and presumably some functions with grayware jars. Perhaps the frequency of coarse tempers relates to the trachyte frequency--trachyte is often coarse in graywares but less often so in whitewares. Both white and graywares show significant change in grain-size distribution through time (Table MF-1.37). In both wares the basic tendency is toward use of finer tempers--the A.D. 1120-1220 segment is very high on "fine" in both wares. Earlier whitewares tend to associate with medium rather than coarse or very coarse tempers.

Temper Co-occurrences

Some very definite patterns of co-occurrence between whiteware surface finish and trachyte temper are present (Tables 1.38, 1.39, MF-1.37). Both slipping and polishing were carried out more extensively more often on trachyte-tempered vessels than on the rest of the collection. No measurement of degree was made for either attribute, but the trachyte-tempered items are definitely dominated by overall ("total") slipping and maximum polishing (total on both sides on bowls). The category "slip-slop" is descriptive for bowls, but somewhat ambiguous for closed forms--we must assume that slip-slopped jars are also totally slipped on the exterior (empirically this is not a bad assumption). The sandstone-dominant, trachyte temper group contains an inordinate number of slip-slopped items in both the bowl and closed categories. Contrary to the similarity in form distribution between sandstone-trachyte and sherd-dominated, the sherd group is more likely to exhibit slip-slop and more likely to have no slip or polish. An important Chi-square contribution is made by the low frequency of sherd-tempered bowls polished on both sides, but the largest deviation remains the trachyte element. On the whole, sandstone and sandstone-trachyte have slip and polish distributions intermediate to those of trachyte and sherd-dominated items.

The association of unmixed trachyte temper with carbon paint is clear by inspection in all time periods, even with the increase of other tempers found in carbon-painted items in the latest contexts (Table 1.40). In the A.D. 1020-1120 group no association is present between mineral paint varieties and the more abundant tempers (Table MF-1.37). However, within the trachyte-containing sherds in both the A.D. 1020-1120 and A.D. 1120-1220 segments, there are strong associations (C = .459 in A.D. 1020-1120) between "pure" trachyte and carbon paint (these can contain sherd temper) and sandstone-trachyte and mineral paints. Trachyte-with-sand-tempered vessels fall in between--they are much more frequently carbon-painted than are sandstone-trachyte or especially sandstone vessels, but far less than unmixed trachyte.

Trachyte temper also behaves distinctively in regard to the co-occurrence of sherd temper, or, in this case, lack of co-occurrence. In the A.D. 1020-1120 group trachyte and trachyte-sandstone make up 20 percent of the whiteware, but are 50 percent of the sherds with no sherd temper (Tables 1.41, MF-1.37). Both the sandstone and sandstone-trachyte are below expected when sherd temper is absent; as the source of the trachyte in the latter group is likely to be sherd temper, this is something of an autocorrelation. In the whitewares there is a significant trend of increasing use of sherd temper, but the trend, though present, is not significant in the graywares. Sherd temper is rare in the earliest graywares, consistently found in about 8 percent of the middle time groups and climbing to 12 percent in the latest segment. Chalcedonic sandstone tempers have consistently less sherd temper than the overall sample; Table 1.41 shows that there is a greater tendency for chalcedonic sandstone temper to occur in graywares, and that in grayware it is more likely to be the pink variety than the white. The two colors of chalcedonic cement do not seem to differ much in the associated quantities of sherd temper.

Table 138. Polish on whitewares by major form lumps and major temper types, Pueblo Alto.

	Absent	Streaky Interior	Moderate Interior	Total Interior	Streaky Two Side	Moderate Two Sides	Total Two Side	Differential[b]	Total
BOWLS									
Undifferentiated SS	19	10	17	108		4	44	31	233
More sherd than SS	69	20	49	263	4	2	61	59	527
Chalcedonic SS	6		4	14			6	6	36
Tusayan SS		1		14			3	6	24
San Juan igneous		1	3	12			9	5	30
Trachyte	5	1	4	103		1	95	36	245
More SS than trachyte	5	1	8	82		2	30	9	137
Socorro						1	3		4
Unidentified igneous		1	3	14			20	5	43
Totals	104	35	88	610	4	10	271	157	1,279
LADLES									
Undifferentiated SS	2	1	2	10		1	4	6	26
More sherd than SS	8	4	7	17		1	12	3	52
Chalcedonic SS	2		1			1		1	5
Tusayan SS								1	1
San Juan igneous				2			1		3
Trachyte	1			13		2	25	4	45
More SS than trachyte	1		3	5			2	2	13
Unidentified igneous				1			3	2	6
Totals	14	5	13	48		5	47	19	151

	Absent Exterior	Streaky Exterior	Moderate Exterior	Total Exterior	Total
CLOSED					
Undifferentiated SS	14	4	11	88	117
More sherd than SS	34	14	45	212	305
Chalcedonic SS	2	1	3	3	9
Iron-bearing SS				1	1
San Juan igneous			2	11	13
Trachyte	4		5	132	141
More SS than trachyte	6		10	84	100
Socorro				1	1
Unidentified igneous	4			7	11
Totals	64	19	76	539	698

[a]Miniatures, effigies, and unknowns excluded.
[b]Total interior with partial exterior polish.

Table 1.39. Slipping on major whiteware form classes by temper type with unknown tempers and forms and miniatures omitted, Pueblo Alto.

	Absent	Interior	Exterior	Slip-slop	Interior-Exterior	Total
BOWLS						
Undiff. SS	19	66	2	40	100	227
Sherd > SS	47	222	8	82	182	541
Chalced. SS	5	6		2	24	37
Iron-bear. SS				1		1
Tusayan SS	1	18			6	25
San Juan ign.	1	8		2	19	30
Trachyte	5	66	2	33	138	244
SS > Trach	7	56		39	39	141
Soccorro	2				2	4
Unident.ign.	1	15		8	21	45
Totals	88	457	12	207	531	1,295
LADLES						
Undiff SS		7	1	4	16	28
Sherd > SS	5	14	4	6	26	55
Chalced. SS	2	1			2	5
Tusayan SS					1	1
San Juan ign.					3	3
Trachyte	1	5	4	3	32	45
SS > Trachyte		3	2	2	6	13
Unident ign.		1		2	3	6
Totals	8	31	11	17	89	156
CLOSED						
Undiff SS	8		84	29	1	122
Sherd > SS	25		260	43	1	329
Chalced. SS			8	2		10
Iron-bearing SS			1			1
San Juan ign.			9	4		13
Trachyte	4		113	27	4	168
SS > Trach	3		83	15		101
Socorro	1					1
Unident. ign.	3		5	2		10
Totals	44		563	122	6	735

Table 1.40. Pueblo Alto paint types co-occurring with whiteware tempers through time.

Time/Temper	NONE	MINERAL Red	MINERAL Brown	MINERAL Black	MINERAL Green	MINERAL Glaze	CARBON	TOTAL
A.D. 920-1020/								
Undiff. SS	1	3	20	96		1	1	122
Pink Ch SS			1	1				1
White Ch SS				5				5
San Juan ign.				3				3
Trachyte							8	8
Trach + SS				1			4	5
SS > Trach			3	5				8
Unident. ign.				1				1
Totals	1	3	24	112		1	13	155
A.D. 1020-1040/								
Undiff SS	1	1	22	104	2	1		131
Pink Ch SS	1		1	6				8
White Ch SS			1	2				3
Magnetitic SS				1				1
Tusayan SS							1	1
San Juan ign.			1	2				2
Trachyte			1	1			6	8
Trach + SS	1		5	6			2	14
SS > Trach	1		6	17		1		25
Socorro				1				1
Unident. ign.		1		3				4
Totals	4	2	37	142	2	2	9	198
A.D. 1020-1120/								
Undiff SS	9	12	176	523	8	28	6	760
Pink Ch SS	2		1	12				15
White Ch SS			6	7				13
Magnetitic SS			1					1
Tusayan SS							14	14
San Juan ign.			7	14	2	1	1	25
Trachyte	4	3	18	26	1	2	55	109
Trach + SS	2	4	30	75	2	4	23	141
SS > Trach	2	2	45	99	1	4	4	157
Socorro				1				1
Unident. ign.		1	12	14		1	1	29
Totals	19	22	396	772	14	40	104	1,276
A.D. 1020-1220/								
Undiff SS	4		24	60	1		5	94
Pink Ch SS			1					1
White Ch SS				1				1
Tusayan SS							1	1
San Juan ign.				2			5	7
Trachyte			2	1	1		9	13
Trach + SS			1	5		1	5	12
SS > Trach			3	11		1	2	17
Socorro				1				1
Unident. ign.			1	2		1	2	6
Total	4		32	83	2	3	29	150
A.D. 1120-1220/								
Undiff SS	13	5	52	89	6	6	70	241
White Ch SS			1	2				3
Tusayan SS							10	10
San Juan ign.			1	3	3		2	9
Trachyte	1	1	3				54	59
Trach + SS	4		5	8	1	2	58	78
SS > Trach	3	1	10	10	1		37	62
Socorro				1		1		2
Unident. ign.	1		2	1	2	2	13	19
Total	22	7	74	114	13	11	244	485

[a]"Unknown" paint items omitted.

Table 1.41. Pueblo Alto temper types tabulated by estimated amount of sherd temper by time segment.

A. Graywares

Time/Amount	Undiff. SS	Chalcedon. SS—pink	Chalcedon. SS—white	Iron SS	San Juan igneous	Trachyte	SS> Trachyte	Unident. igneous	Total
A.D. 920-1020/									
Absent	31	1	5	1		23	2		63
Less than half	1								1
Totals	32	1	5	1		23	2		64
A.D. 1020-1040/									
Absent	30	3	4	4		39	1		81
Less than half	3								3
More than half	4								4
Totals	37	3	4	4		39	1		88
A.D. 1020-1120/									
Absent	287	33	17	11	9	457	2	3	819
Less than half	23	2	3	1	1	15			45
More than half	23					4	1		28
Nearly all sherd temp.	4								4
Totals	337	35	20	12	10	419	3	3	896
A.D. 1020-1220/									
Absent	29	1	3	2	1	34	6		76
Less than half	4					1	1		6
More than half	1								1
Totals	34	1	3	2	1	35	7		83
A.D. 1120-1220/									
Absent	68	5	2	1	2	113	1		192
Less than half	10	2			2	5	1		20
More than half	4					1			5
Nearly all sherd temp.	2								2
Totals	84	7	2	1	4	119	2		219

B. Whitewares

Time/Amount	Undiff. Sandstone	Chalced. SS-pink	Chalced. SS-white	Iron SS	Tusayan SS	San Juan igneous	Socorro	Trachyte	SS> Trachyte	Unident. igneous	Total
A.D. 920-1020/											
Absent	5		2			2		6	2		17
Less than half	35	2	1			1		4	3		46
More than half	77	1	2					3	3	1	87
Nearly all sherd	5										5
Totals	122	3	5			3		13	8	1	155
A.D. 1020-1040/											
Absent	6	3		1	1		1	10	1		23
Less than half	37	4	2			2		7	12	2	66
More than half	85	1	1					5	12	2	106
Nearly all sherd	3										3
Totals	131	8	3	1	1	2	1	22	25	4	198
A.D. 1020-1120/											
Absent	47	3	5		13	8		89	10	2	177
Less than half	165[a]	6	7		1	9	1	93	66	13	361
More than half	497	6	1	1		8		66	80	11	670
Nearly all sherd	64							2	1	3	70
Total	773[a]	15	13	1	14	25	1	250	157	29	1,278
A.D. 1020-1220/											
Absent	7				1	4		9			21
Less than half	21	1				1		11	9	1	44
More than half	63		1			2	1	5	6	5	83
Nearly all sherd	3								2		5
Totals	94	1	1		1	7	1	25	17	6	153
A.D. 1120-1220/											
Absent	24				7	5	2	52	9	2	101
Less than half	50				3	2		50	27	11	143
More than half	145		4			2		37	26	8	222
Nearly all sherd	25							1		1	27
Totals	244		4		10	9	2	140	62	22	493

[a]Includes one item thought to have shale temper.

Whiteware paste types recorded are conditioned by the presence of sherd and, thus, echo somewhat the temper findings; temper-paste co-occurrences are further influenced by the nearly exclusive use/occurrence of homogeneous "Chuska gray" with trachyte temper. Nonetheless, some temper-paste combinations may show areal preferences and/or products (Tables MF-1.37, MF-1.40) as follows.

(1) Predominantly sherd-tempered items are most likely to be characterized by gray body clay and white sherd temper, and, second, by black and white mixed sherd temper; probably because of the availability of more categories, this temper group is the most likely to fit into a defined paste type (i.e., it has the fewest "no type" items).

(2) Gray paste with white sherd temper is also the most frequent category in sherds with trace quantities of trachyte, less than half sherd and sandstone, and sherd-bearing combinations in the trachyte group.

(3) The sandstone group has a substantial portion consisting of white-firing clay.

In the graywares, tests of just clay color are possible and show a strong association with temper even with the elimination of Chuska gray (Tables MF-1.37, MF-1.40).

(1) As at other sites, there is a frequent co-occurrence of tan clay with trachyte. It may be that this is a firing variant of Chuska gray--the tan found with trachyte is usually darker and grayer than that found with other tempers. Black and white clays are rarely found with trachyte temper.

(2) Black clay _is_ found most frequently with sandstone temper.

(3) White clay forms a higher percentage of chalcedonic sandstone-tempered graywares than other temper groups.

Apparent vitrification also shows significant temper associations (Tables MF-1.37, MF-1.40). In the whitewares the differences are all in terms of presence and absence--the occurrence of markedly vitrified items is proportional in all temper classes (mostly 14-17 percent). The sandstone group has a decidely higher frequency of unvitrified specimens as compared to the sherd, chalcedonic sandstone, and sandstone-trachyte-tempered groups; it should be remembered that vitrification is either less likely or less visible on white pastes, which may influence this result. The graywares, tested only for presence-absence because of the infrequency of markedly vitrified examples, present a different picture, as the sandstone group contains a significantly higher percentage of vitrified items.

Grayware Sooting

The presence of carbon deposits on grayware exteriors is regarded here as the most secure indicator of at least one use to which a particu-

lar vessel has been put. If a jar exhibits sooting, we assume that it was used over a fire, presumably for cooking. There are more things about such a jar that are not known than are--what it contained and if it was used for several other purposes, for example--but that it spent some time on a fire is more than is known about most other vessels' functions. Soot seems to last remarkably well but it is not permanent. There is evidence from 29SJ 627 and 29SJ 629 that sherds from the surface probably have been scoured, because the presence-absence ratio of sooting is far below other, buried sherds. At 29SJ 627, however, sherds from three groups thought to have experienced different lengths of exposure showed no significant difference in soot distribution.

Except for 30 grayware sherds from the Trash Mound, the detailed-analysis sample from Pueblo Alto contains no surface sherds, but there is, again, the possibility of different exposure times before burial. For example, all of these surface sherds are unsooted (they are not included in the temper sample, but they are in TS Group Y). Except perhaps for Booth 6, the other proveniences included in the final sample--rooms, pit-structures, and the uneroded portion (Booths 1-5) of the Trash Mound--all were probably reasonably protected. On the whole, the typological pattern at Pueblo Alto conforms well to that at the smaller, earlier sites--that is, there is a strong trend of increase in sooting presence through time regardless of deposit type (Table 1.42). Thus, less than half of the grayware in all the contexts assigned to time periods before A.D. 1040 is sooted, and more than half of those from almost all later contexts is sooted.

The latest group (A.D. 1120-1220) has the highest incidence (58.5 percent) of sooting. Pueblo Alto and 29SJ 633 are the two latest sites tested by the project, and they both have high percentages of sooting compared to the other sites. The sherds from 29SJ 633 are both probably contemporaneous with Alto (below the upper floor) and clearly later than Pueblo Alto. Although the sooting percentage at 29SJ 633 is higher than it is at either 29SJ 629 or 29SJ 627, it is less than the overall occurrence at Pueblo Alto (50.4 percent) and much less than some of the later levels in Kiva 10 (see also Toll 1983).

The Trash Mound shows this increase within a single deposit. The earlier segments are markedly low in sooting, but the larger A.D. 1020-1120 segment is slightly over half sooted. The ambiguous A.D. 1020-1220 group shows the highest percentage of unsooted items, making it the exception to the post-A.D. 1040 trend toward increased sooting. Even with the elimination of the 30 surface sherds, this group is exceptionally low in sooted items. As discussed in the Trash Mound section, the booth sequence shows some deviation from increased sooting through time, because of the lower sooting percentage in the final booth (Booth 6), which constitutes 52 percent of the problematic A.D. 1020-1220 midden group (Table 1.30). Though no surface sherds are present in the booth samples, the contents of the two major layers in Booth 6 were likely to have been exposed to more weathering than the rest of the mound. The rooms, both fill and floor, contain the highest percentages of sooted graywares.

Table 1.42. Grayware sooting by time-space group, Pueblo Alto.

Time-Space Group	Sooting		
	Present	Absent	Total
A.D. 920-1020			
A--room fill	2	4	6
B--pitstructure fill	6	13	19
C--plaza fill	5	6	11
D--midden	12	15	27
A.D. 1020-1040			
J--midden	26	62	88
A.D. 1020-1120			
E--room fill	19	8	27
F--room floors	45	7	52
G--pitstructure trash fill	13	11	24
H--pitstructure fill	6	1	7
I--midden	663	647	1,310
A.D. 1020-1220			
X--fill	12	6	18
Y--midden	16	76	92[a]
Z--room fill	10	2	12
A.D. 1120-1220			
K--room fill	13	4	17
L--pitstructure trash fill	116	86	202
Totals	964	948	1,912
Provenience type sums			
Room fill (A,E,K,X)	46	22	68
Floors (F)	45	7	52
Trash fill (B,G,L)	135	110	245
Midden (D,I,J,Y)	717	800	1,517
Type totals			
Wide neckbanded	7	10	17
Narrow neckbanded	53	57	110
Neck corrugated	9	15	24
Pueblo II corrugated	226	166	392
Pueblo II-III corrugated	74	41	115
Pueblo III corrugated	28	18	46

[a]30 unsooted in Group Y from the surface

Table 1.42 (concluded)

	Sandstone	Ch.SS	Trachyte	Other	Total
A.D. 920-1020					
Sooted	9	2	13	1	25
Unsooted	22	4	12		38
Totals	31	6	25	1	63
A.D. 1020-1040					
Sooted	8	3	12	1	24
Unsooted	29	4	28	3	64
Totals	37	7	40	4	88
A.D. 1020-1120					
Sooted	172	27	277	13	490
Unsooted	165	26	199	14	404
Totals	337	53	476	27	894
A.D. 1020-1220					
Sooted	19	3	13	3	38
Unsooted	15	1	29		45
Totals	34	4	42	3	83
A.D. 1120-1220					
Sooted	45	4	77	3	129
Unsooted	39	5	42	4	90
Totals	84	9	119	7	219

A. D.	Orifice Diameter Means Through Time				
	n	mean	s.d.	min.	max.
920-1020 sooted	8	180.0	37.417	110	220
920-1020 unsooted	22	199.1	43.906	120	300
1020-1040 sooted	15	209.3	49.429	90	280
1020-1040 unsooted	30	192.3	50.116	80	300
1020-1120 sooted	385	210.4	61.169	70	350
1020-1120 unsooted	349	210.7	60.359	70	350
1020-1220 sooted	19	195.0	62.805	105	300
1020-1220 unsooted	42	211.2	62.233	70	330
1120-1220 sooted	109	217.8	56.238	70	350
1120-1220 unsooted	70	210.7	60.351	100	350

The apparent period of adjustment between the Trash Mound and later Kiva 10 was discussed at some length above (Ceramic Trends section). Samples are again small, but it is intriguing that sooting occurrence reflects this period as well. That is, there is an increase in sooting through Booth 3 (62.6 percent) followed by a slow decrease to Booth 6 (52.8, 49.7, 41.4 percent--Table 1.30) that bottoms out in Kiva 16 (37.0 percent), climbs slightly in Layer 4 of Kiva 10, and then goes very high in upper Kiva 10 (reaching 92 percent maximum in a single unit--Table MF-1.35). This is not as dramatic as the image of the tempers, forms, and types, nor is it perfectly synchronized, but there is some apparent relationship.

The trend to increased sooting may also be observed typologically. At 29SJ 627 there is an unbroken increase from wide neckbanded (32.6 percent) to PII-III corrugated (58.1 percent), tailing off in PIII corrugated (48.8 percent). At Pueblo Alto almost the same curve shape is observable, except that the small, neck corrugated group has a lower percentage of sooted than either wide or narrow neckbanded. With that exception, five of the six types in question have higher sooting frequency at Pueblo Alto than at 29SJ 627 by 6 (PII-III corrugated) to 12 percentage points (narrow neckbanded, PIII corrugated). In spite of the consistently higher sooting percentages at Pueblo Alto, type-by-type Chi-square comparisons of 29SJ 627 and Pueblo Alto sooting show significant differences at .05 only in narrow neckbanded (Table MF-1.37). Comparison of the cumulative counts shows a significant difference, but the within-type similarity corroborates the trend of increase through time.

The other accessible attribute that gives some inkling of function of gray jars is rim diameter--if the sooting distributions reflect functional changes, perhaps some reflection may also appear in diameter distributions. The results of limited analysis of sooting and diameter are inconclusive. In the most numerous time group (A.D. 1020-1120) the mean diameter estimates for sooted and unsooted jars are within a millimeter, with similar coefficients of variation and frequency plots (Table 1.42). The specimens from the A.D. 1120-1220 segment, however, show the sooted jars to be somewhat larger than the unsooted; although the frequency difference is marked, there is still substantial overlap. In the smaller A.D. 1020-1220 and A.D. 920-1020 groups the means for the unsooted items are larger, whereas in the A.D. 1020-1040 segment the sooted portion has the larger mean. Apparently, then, there was sufficient overlap in vessel size requirements for the two or more functions that resulted in these end states that no difference is now apparent, and/or, as has been suggested, a single vessel was likely to have been used for both functions.

Elsewhere we have failed to find significant associations between temper and sooting, though there are suggestions that trachyte might contribute to thermal shock resistance (Rye 1976; Toll 1984). A breakdown of sooting by time period by temper shows that in four out of five time groups sooting is more frequent on trachyte than on sandstone-tempered vessels (Table 1.42). In three out of four of those, however--the exception being the early group--both of the predominant tempers follow the

temporal trend and the differences are small. The A.D. 1020-1220 group shows up as once again anomalous, as more of the sandstone-tempered sherds are sooted than not (as time would suggest they "should be"), whereas the trachyte sherds are the reverse. There is a potential paradox here--if trachyte-tempered jars were, in fact, more durable as cooking jars, they would have broken less often, and, therefore, the sooting frequencies might be lower than actual cooking-time usage per vessel. With recognition of this hypothetical durability, presumably trachyte-tempered jars would be more heavily used for cooking and, thus, exposed to risk more often, perhaps partly correcting the paradox.

Possible interpretations for the distribution of sooting occurrence at Pueblo Alto have been put forward in the Time-Space section. As with form and temper distributions, these are complicated because of the separation of functional from stylistic trends, especially because some stylistic change results from change in function. The increase of sooting through time bespeaks a probable change in cooking methods; Windes (personal communication) has suggested that there was a long-term shift toward use of pots instead of baskets for cooking or, at least, basket techniques that would not involve placing the vessel directly over the fire (such as stone boiling). This idea has considerable appeal, but the length of the transition--perhaps 700 years--seems great.

R. G. Vivian (personal communication, 1987) suggests that this trend in sooting may have its basis in changes in fuel types, perhaps a shift away from hotter, cleaner juniper toward sootier pinyon due to depletion of juniper. The composition of fuel wood in Chaco sites, however, does not display this temporal trend--coniferous fuel wood surprisingly increases--and juniper is found more frequently than pinyon (M. Toll 1985:256-258). Fuel may nonetheless have an effect on sooting: The smaller sites (29SJ 627 and 29SJ 629) show a higher use of non-coniferous wood, which may also deposit less soot. Pueblo Alto deposits contain more coniferous fuel than the small sites in all temporal contexts (M. Toll 1985:257), which could well relate to the generally higher frequency of sooted vessels at Pueblo Alto than at the smaller sites (Toll 1984:127), though the temporal differences in sooting at both types of sites and the fact that Pueblo Alto deposits are on the whole later must be remembered.

Against the temporal trend is counterposed a functional one. If there were a specialized storage function in the A.D. 1020-1120 period, for example, fewer jars would have been sooted. Perhaps supporting such an interpretation is the high occurrence of sooting in the rooms and in the late trash deposits in Kiva 10. That is, the Kiva 10 refuse represents household activity only, the Trash Mound either something else or a combination of something else and household activity. The fill of Kiva 13 (TS Group G) has a higher percentage of sooted items than the contemporaneous Trash Mound (54 versus 51 percent) but not to the extent seen in rooms or in Kiva 10. The low percentage of sooting in Kiva 16, however, is difficult to place in this scheme.

Ground Bowl Rims

Another attribute with inferential functional meaning is that of ground bowl rims. The recording procedure followed was to call a bowl any sherd that was finished on the interior and had bowl shape, if it lacked any trace of a ladle handle. More often than not, whole ladles exhibit a bevelled rim opposite where the handle attaches to the ladle bowl. These ground edges were recorded, and for the analysis a computer-generated category of "ladle bowl" was used for "bowls" with ground edges and estimated diameters of less than 195 mm. There is a risk that some bowls used as dippers are thus included as ladles, but the error is probably a small one. Of all bowls and ladles with ground rims, 94 percent are 185 mm in diameter or less, and 80 percent fall in the 70-145-mm range (n = 157), most commonly from 90-125 mm (49 percent). This is true for all the types in which ground rims occur in any abundance.

To assess the use of 195 mm as a cut-off diameter, frequencies and means for the forms that contribute to the ladle category were generated. Very few of the items coded as ladle handles had enough of the bowl intact to make a diameter measurement. In Puerco and Gallup, respectively, with the two largest groups for examples, 1 of 16 and 3 of 17 of the pieces coded as having at least part of their ladle handles also had diameters recorded. On the whole, the means for such rare items are quite similar to those for the ground rim "ladle bowls," when the few larger than 195 mm are excluded. If anything, 195 mm is probably a bit high as a cut-off, as the largest type mean is around 125 mm and most others around 100 mm. The Gallup mean plus two standard deviations (using the 195-mm cut-off) is about 175 mm, which would probably be better. Best, of course, would be actual measurements on a large series of ladles.

As noted in the Types section, Gallup ladles as a whole were found to be significantly larger ($\overline{x}$ = 123.9) than those in other type groups (Table MF-1.18). Larger, Gallup ladle diameters are suggested by the more complete specimens as well. More examples are needed in all types, but those available show Gallup as the largest. There is an immediate temptation to infer that these large ladles are the result of their role in large-group activity, but two factors (at least) mitigate that temptation:

(1) the PII-III carbon-on-white mean for ground-edge bowls is nearly as large ($\overline{x}$ = 120.0, n = 5), suggesting that it may instead be a temporal phenomenon, though inclusion of all ladles reduces this type's mean to a size more similar to all other types ($\overline{x}$ = 106.7 mm); and

(2) ladles in the Trash Mound are proportional in frequency to other deposits or less relatively frequent.

Whole Vessels at Pueblo Alto

Intact vessels in primary context--that is, found where they were used--containing identifiable material truly provide the basis for reli-

able, functional interpretations. The Pueblo Alto ceramics tend to be at the other interpretational extreme--a total of 3 was complete, and a total of 12 was found in floor contact or intentional placements, and none contained identifiable prehistoric material. The Trash Mound may be "primary refuse" (Schiffer 1972) but not necessarily; the mound is excluded from these counts of primary context because it cannot be considered a ceramic use area. Only about 38 vessels are largely or totally present in either whole or fragmentary condition (Tables 1.43, MF-1.41). Because a number of those 38 are not complete, the number is somewhat subjective, as no precise cut-off was used for those included for consideration as restorable. However, the latter give a reasonable idea of the condition of the assemblage. Although the circumstances are far from ideal for interpretations of function, the distribution of fairly complete vessels does contain some cultural and depositional information.

Almost half of the restorable vessels found in primary contexts are small--five of the six miniatures are from such contexts and the one bowl from a primary living-room context is well below its type's mean diameter. The four, miniature, crude mudware bowls were found in pairs in special pits at the bottom of two of the large "ovens" in the Plaza Feature and seem certain to have had some ritual significance (Plate 1.12). The small vessels found in Posthole 45 of Room 110 are more ambiguous--they were in the pit fill rather than placed at the bottom of the pit. Miniature vessels are frequently interpreted as toys (e.g., Judd 1954: 215), which these could have been; mention is also occasionally made of miniatures as a part of firing (Judd 1954:215) or use in burials, both of which seem less likely here. In a purely depositional sense, small size certainly reduces the likelihood of fracture and dispersal of parts, which partly accounts for the high frequency of miniatures among the whole vessels as compared to the low frequency in the overall vessel-form counts.

The four gray jars listed as restorable in Table MF-1.41 are all partial--only that from Room 145, Floor 1, could be reconstructed sufficiently to make a volume measurement. The only grayware item that survived anywhere near intact was yet another miniature. All of these large pieces of grayware jars were recovered from rooms--two in contact with the floor, and two in the floor fill and, thus, perhaps also "primary." Windes (personal communication) has remarked upon a tendency for short, squat, culinary jars to be found on room floors. That from Room 145, Floor 2 conforms to that observation, as do the two vessels from Room 103 (Plates 1.1, 1.11). The gray jar from the firepit of Room 110 has a relatively large orifice diameter of 25.5 cm, but, once again, the apparent height makes it a small jar for a grayware.

The vessel counts from sherds indicate that raw frequencies and percentages of gray jars are high in the Trash Mound, but no restorable gray vessels have been identified from the mound. Contrary to the vessel assemblage apparent from the sherds, 11 of the 12 restorable vessels from the Trash Mound are bowls, the exception being a miniature grayware pitcher from the building-debris portion of the mound. These bowls come from tightly localized areas of the Trash Mound, and six of them are high-

Table 1.43. Summary of Pueblo Alto whole vessel forms and distribution.

	Kivas	Rooms w/ Fl.Feat[a]	Rooms w/o Fl.Feat[b]	Plaza/ OS	Trash Mound	Total
Bowl	2	1	3	2	11	19
primary	(2)	(1)	(2)			(5)
Ladle		2				2
primary		(1)				(1)
Canteen		1	1			2
Pitcher	1					1
Olla			2	1		3
Duckpot			1			1
primary						(1)
Miniature		5			1	6
primary		(5)				(5)
Red Jar		1				1
Gray Jar		3	1			4
primary		(1)				(2)
Total	3	13	8	3	12	38
Primary context	(2)	(8)	(2)			(12)

[a]Includes Plaza Feature Room 3.
[b]Includes unexcavated Rooms 221 and 233.

Key to Types:

3 Red Mesa Black-on-white
2 Puerco Black-on-white
9 Gallup Black-on-white
2 Chaco McElmo Black-on-white
2 Mancos Black-on-white
2 McElmo Black-on-white
1 Toadlena Black-on-white
1 Nava/Crumbled House
1 Reserve Black-on-white
1 PII-III Carbon-on-white
1 Black Mesa Black-on-white
1 Puerco Black-on-red
1 Tusayan Black-on-red
2 Forestdale smudged
1 PII corrugated
4 mudware

Plate 1.12. Mudware miniatures from Plaza Feature 1 firepits.

ly fragmented--so fragmentary, in fact, that intentional comminution may be suspected. Although it is not possible to make any definite link, the following description of a nineteenth-century, Zuni initiation possibly is pertinent.

> From housetop to housetop they [the Salimopiya and Shulawitsi--directional guardians and fire god] go, throughout the pueblo, casting down the rarest vessels--set out to await them--and breaking up baskets and all other food vessels not hidden before their approach. As each vessel strikes the ground, the Sa-la-mo-pi-a rush upon it and dance it into the ground.... [Cushing 1974: 615, reprinted from 1920].

This ceremony took (takes?) place every four years in the winter. To pursue the analogy, the two groups of broken bowls occur in Booth 5, Layer 58, and in Grid 183, Level 10, which translates to Layer 32, 34, or 35 (a single smashed bowl is also present in Layer 55, Booth 5, which by projection, is stratigraphically very near Layer 58). If the bowls came from Layer 35, they would be about six major layers lower than Layer 58; if they came from Layer 32, around eight. Akins' seasonal assignments designate Layers 55 and 58 as winter and Layers 32, 34, and 35 as fall. It may be, then, that these vessel destructions took place at some regular interval.

Talayesva (Simmons 1942:315) also describes breaking a bowl after using it for ritual cleansing:

> They poured the water into an earthen dish and took it outside to a special place where we removed our clothes and bathed...We broke the pottery dish so that it could not be used again and bring bad luck upon anyone. [emphasis added]

The larger Forestdale smudged bowl (Grid 239) may also have been a sacrifice in that it occurs at the very bottom of the mound; alternatively, Forestdale smudged is usually a soft pottery prone to fragmentation--the question remains why so many fragments are in the same place. On the whole, however, the lack of restorable vessels from the Trash Mound and Kiva 10 suggests that they were basically trash deposits, to which broken vessels were removed, rather than scenes of some sort of southwestern potlatch. In Kiva 10 in particular, large fragments of vessels are represented, but none constitutes even half a vessel. This is surely partly a result of the trench sampling, but also indicates that the vessels were broken before being deposited. This being the case, if the fragmented bowls in the Trash Mound were intentionally broken, it is likely that they are redeposited heaps of vessels dispatched elsewhere on the site.

Given the small number of whole vessels found in moving a large quantity of fill, it is noteworthy that four were found during wall clearing, a procedure that ideally kept disturbance of primary deposits to a minimum. These vessels are all typologically relatively late and all from the southwestern part of the site. They also include the most nearly com-

plete, large, closed form recovered--a high-volume Chaco McElmo olla (Plate 1.9). The small irregular rooms in this area have shallow floors relative to those in the main roomblocks, so the context of some of these vessels was probably "primary." Their occurrence also suggests where at Pueblo Alto one might look to find artifacts of use in situ, and perhaps where people last lived at the site (systematically removing everything from the other rooms). Another large, late olla ("Nava/Crumbled House" Black-on-white, Plate 1.8b) was recovered from a great many proveniences in the North Block area.

The closed whiteware forms indicate that forms termed "special" in the analysis, such as canteens and pitchers, as well as ollas, probably make up a larger portion of the vessel form assemblage than the counts from sherds indicate. Although there is a class of vessel that would be termed "whiteware jar" (the Mancos "olla" in Table MF-1.41 is perhaps more properly such a form), it is an inflated category because of the difficulty of determining more specific shapes from sherds.

Finally, as at 29SJ 627, the whole vessels include disproportionate quantities of exotic types and forms--San Juan McElmo and Mancos, a redware jar, a Black Mesa bowl, and two polished smudged bowls. There may be several reasons for this:

--such vessels were curated for their exotic nature;

--these particular vessels are mostly late and were thus exposed to fewer risks;

--many come from parts of the site that were totally excavated (mainly rooms) where a more complete recovery is likely, whereas a partially excavated provenience (Trash Mound, Kiva 10) is prone to partial recovery; and

--these vessels are more easily matched because of their distinctiveness.

The most abundant, decorated type from Pueblo Alto, Gallup, is represented by only one relatively intact vessel, and that is a miniature. Two cultural (rather than archeological) factors may be operating in this occurrence: first, production of Gallup was presumably minimal by the time Pueblo Alto was abandoned, and, thus, Gallup vessels probably were "used up"; second, Gallup may have been in use during the period for which there is suggestive evidence of "vessel sacrifice," which may have reduced chances for survival of whole specimens.

Refiring Analysis

The subject of oxidized clay color from Pueblo Alto has been treated in two previous papers, one on late carbon-on-white (Toll et al. 1980) and one not generally available on culinary wares (McKenna 1980). This sec-

tion includes all the Pueblo Alto sherds used in the paper on carbons but only some of those in the culinary-ware paper, as McKenna used a number of ceramics not in the final-analysis sample. In addition, several more black-on-white ceramics were refired for this discussion, which brings the total count included to 169 (Table MF-1.42). Twenty-eight different Munsell colors have been recorded; following Windes (1977:292), we consolidated these into seven color groups plus "gray" for items that did not noticeably change color. McKenna instituted one change in Windes' color group system and treated 7.5YR 8/6 as Group 3 instead of Group 4, and this color is a common one, so the change does have an appreciable affect on the sizes of the two groups.

The color groups range from light buff (Group 1) through buff (Groups 2-3), yellow-red (Groups 4-5), to red (Groups 6-7). The conventional wisdom holds that buff and light, yellowish red clays are Cretaceous in origin in the San Juan Basin, whereas redder clays are from stream deposits or non-Cretaceous (igneous?) origins (Toll et al. 1980:96, 104; Wilson 1980:491; Windes 1977:290-293, 357). Raw clay sample oxidation tests of Cretaceous clays from Chaco Canyon have shown that there is considerable variability within formations, but there is some assurance that truly red clays are unlikely to come from central San Juan Basin deposits [Toll et al. 1980:104; McKenna and Toll n.d.].

The refiring sample was drawn with specific questions in mind--it is decidedly not representative of the whole Pueblo Alto collection. The questions directing selection for refiring are the following.

(1) Particularly because of the sudden increase carbon-painted whitewares, there is considerable question as to whether a large portion of the late ceramics with this paint could have been locally produced.

(2) Mineral-painted sherds containing varying quantities of trachyte are also of ambiguous origin, and some light may be shed on the problem through refiring.

(3) Sherds available from a thin-section analysis were refired to look for cooccurrences with the greater detail of that analysis.

(4) A series was done to look for variation in clay source in the Chuska graywares through time, with the use of non-trachyte-tempered graywares as a large lump for comparison (McKenna 1980).

Clearly much larger numbers of sherds would be desirable for even these few questions, but time constraints and, in some cases, availability operated against such wishes.

<u>Carbon-painted Whitewares</u>

The carbon-on-white ceramics in Table 1.44 are all from Kiva 10 (mostly from the matched vessels used in Toll et al. 1980). With the

Table 1.44. Refiring colors by temper in gray, mineral, and carbon groups, Pueblo Alto.

	COLOR GROUP								
	Buff 1	2	3	4	5	6	Red 7	Gray	Total
Grayware									
Undifferentiated SS	6		6	1	2			5	20
Sherd > sandstone	1	1							2
Chalcedonic SS	3	1							5
Magnetitic SS	2	1							3
San Juan igneous		1							1
Trachyte	5	2	6	1	12	12		1	39
Trachyte + sandstone	—	—	—	1	1	1	1	—	4
Total grayware	17	6	12	3	15	13	1	6	73
Mineral-on-white									
Undifferentiated SS	1								1
Sherd > sandstone	7	2		1					10
Trachyte								1	1
Trachyte + sandstone	2	2	2	1					7
Sandstone > trachyte	3	3	3		2	1			12
SS > unid. igneous	1	—	—	—	—	—	—	—	1
Total mineral	14	7	5	2	2	1		1	32
Carbon-on-white									
Undifferentiated SS	5	1	1						7
Sherd > sandstone	3	3	1						7
Tusayan sandstone					1				1
Trachyte	1		2	1	6	5			15
Trachyte + sandstone	4	6	1	1	5	3			20
Sandstone > trachyte	2	2	4					1	9
Unid. igneous + SS			1						1
SS > unid. igneous	2	1	1	—	—	—		—	4
Total carbon	17	13	11	2	12	8		1	64

single exception of a sherd typed as Tusayan whiteware, all of the non-trachyte-tempered sherds refired to some variety of buff. The trace trachyte sherds are also all buff (disregarding the "gray" as likely to have been vitrified in manufacture). Reference to Table MF-1.42 shows that the types do not sort quite as well as the tempers, though certainly Chuska Black-on-white and the undifferentiated Chuskan Carbon-on-white sherds contain most of the items in color Groups 4 to 6. The small group of strictly trachyte-tempered carbons is 80 percent yellowish red to red (Groups 4-6), which is a higher percentage than that found in any of Windes' (1977) CGP carbon-on-white type groups except Crumbled House Black-on-white. Because the Pueblo Alto sherds are from Kiva 10, they are likely to be late in the sequence, but, as noted, Crumbled House is very scarce at Pueblo Alto (and one of the three examples of oxidized buff). When the trachyte-plus-sandstone and trachyte-temper groups are combined, the yellowish red and red groups comprise 60 percent of the trachyte-tempered carbons, which is very close to the percentages found by Windes (excluding Crumbled House at 79 percent, these range from Burnham at 48 percent to Newcomb at 61 percent; for all types except Tunicha and Crumbled House, 56 percent of the 947 are yellowish red to red, 13 percent being red firing).

The similarity of oxidation colors and Windes' finding that many CGP sherds contained some sand temper suggest that both of these temper types are Chuskan, but also that they may represent distinctive production techniques, producers, or areas within the larger tradition. It is suggestive that the sandstone-plus-trace-trachyte group has the most members in color Group 3, whereas the sandstone and sherd groups are more frequent in Group 1, perhaps indicating yet another distinct group (Table 1.44). There is nothing in the oxidation colors that gainsays the idea that the sandstone, sherd, and perhaps sandstone-with-trace-trachyte-tempered carbon wares were local to Chaco Canyon, or at least from areas with clays similar to Chaco's. On the other hand, temper and clay also suggest that some--perhaps not many--ceramics typed as Chaco McElmo came from the Chuskas.

Mineral-on-white

Compared to the carbon-paint sherds refired, the sandstone-with-trace-trachyte group behaves less discretely in the mineral-paint sherds, most of which are Gallop. As argued above (Whiteware Paste section), it seems likely that some sherds with this temper are from the Chuska area; the fact that 3 of 12 sherds oxidized to Groups 5 and 6 tends to support that contention. In this case, there is a large difference between the CGP mineral-painted, trachyte-tempered sherds and those from Pueblo Alto. The CGP group is 48 percent red and yellow-red, whereas the Pueblo Alto group is only 22 percent (including all sherds with any trachyte).

The difference is especially striking as the Pueblo Alto sherds are most comparable in terms of design to Windes' Brimhall Black-on-white, which differs from the solid design types in having 63 percent red and

yellow-red clays (Naschitti and Taylor are 30 and 36 percent). This discrepancy may result because the Pueblo Alto sherds are a combination of Chuskan vessels and vessels made elsewhere (Chaco?), using trachyte-tempered sherds for temper. As in the carbons, nontrachyte tempers are nearly all associated with color Groups 1 and 2. Only 3 of the 25 sandstone-tempered whitewares have coarse-grained temper, and all are mineral-on-white. All three oxidize in color Group 1, suggesting, not surprisingly, that coarse sand is probably available near Cretaceous clay sources within the Chacoan ceramic sphere.

Seven of the refired mineral-on-white sherds were from a group sent to Washington State University for thin-section analysis by Gary Chandler and Phillip Rosenberg (two Red Mesa, one Escavada, and four Gallup). All in all, the thin-section analysis agrees fairly well with the "megascopic" analysis in terms of sherd content, but relative quantites differ somewhat more. The binocular microscope estimates of trachyte-to-sand tend to overevaluate the trachyte, the sherd temper percentage, and, somewhat, the overall temper density when compared to the thin-section point counts. As ordinal measures--which is all they were ever intended to be--these estimates still seem meaningful, though "trachyte dominant over sandstone" should be understood as "significant free trachyte" and "sandstone dominant over trachyte" as "trace trachyte present of unknown source and significance."

One Gallup sherd from Pueblo Alto in the thin-section study was found to have more trachyte than sand, though it was coded as having no trachyte. Re-examination of this sherd shows that fine trachyte is visible, but the dark paste obscures the frequency found in thin-section analysis. The refired portion of this sherd is an example of how refiring can dramatically improve temper visiblity--the trachyte content is readily apparent in the oxidized portion. All but one of the thin-sectioned sherds fired to buff, including two with 6 and 42 percent trachyte temper. The one, yellowish red, Gallup sherd was identified as having 2 percent trachyte; this one has trachyte-tempered sherd temper, as do the other trachyte-tempered sherds.

Table 1.45 shows temporal change in refiring color for all whitewares in the Trash Mound and Kiva 10. Generally, both trachyte-tempered and nontrachyte-tempered items increase in the numbers of items with more color. The nontrachyte-tempered cases, however, are rarely any redder than Group 4 in any time period, while the trachyte-tempered cases include a substantial portion that fire red in the Kiva 10 assemblage (see also Table 1.46).

Graywares

McKenna (1980) showed that there is reason to suspect that clay sources used by Chuska grayware potters shifted through time, or at least the clays in the vessels that found their way to Chaco Canyon. He defined

Table 1.45. Refiring colors of trachyte- and non-trachyte-tempered whitewares by provenience.

Whiteware	COLOR GROUP Buff 1	2	3	4	5	6	Red 7	Gray	Total
Booth 2 trachyte	1								1
Booth 4 non-trach.	2	1							3
Booth 4 trachyte		2							2
Booth 5 non-trach.	3	1	3	1				1	9
Booth 6 non-trach.	2	1	2						5
Booth 6 trachyte	1		1	1				1	4
TM general non-trach.	3	2		1					6
TM general trachyte			1						1
Kiva 10 non-trach.	14	7	8		1			1	31
Kiva 10 trachyte	5	6	3	2	11	8			35

Table 1.46. Refiring colors of trachyte- and non-trachyte-tempered gray and white wares by time group, Pueblo Alto final analysis sample only.

	COLOR GROUP Buff 1	2	3	4	5	6	Red 7	Gray	Total
Grayware (A.D.)									
920-1020 non-trach.	4								4
920-1020 trachyte	2	1	3	1	2				9
1020-1040 non-trach.									
1020-1040 trachyte	3	1	2		3	2		1	12
1020-1120 non-trach.	6	4	6	1	2			2	21
1020-1120 trachyte			1	1	8	6	1		17
1020-1220 trachyte						5			5
Whiteware (A.D.)									
1020-1120[a] non-trach.	9	6	2	1	2	1			21
1020-1120[a] trachyte	1	2	2	1	1			1	8
1120-1220 non-trach.	15	6	9		1			1	32
1120-1220[b] trachyte	6	6	3	2	10	8			35

[a]Includes 3 from A.D. 1020-1040.
[b]Includes 3 from A.D. 1020-1220.

a trend from generally lighter-oxidizing clays in neckbanded ceramics, to red in Pueblo II corrugated, to yellowish red in the later corrugated sherds. That there is considerable overlap from type to type is visible in Table MF-1.43, which presents McKenna's results for trachyte-tempered only (Tables MF-1.33 and 1.15 include his sherds not in the detailed analysis). What is clear, however, is that over 80 percent of the PII and PII-III corrugated sherds are made from clays that refire in the red Groups 5 and 6, whereas the earlier neckbanded and neck corrugated groups are less than 40 percent of these clays. Based on the finding that reddish clays outnumber buff in the Trash Mound, trachyte-tempered, corrugated, that the reverse is true in Kiva 10, and that reddish clays are virtually absent in trachyte-tempered corrugated from Kin Kletso, McKenna proposes a shift back toward yellowish red clays in later Chuska culinary ware.

The shift from light to redder is very apparent in both the trachyte-tempered whitewares and graywares from Pueblo Alto; the shift back to buff is not evident (Table 1.46). The shift proposed by McKenna is based on a mild predominance of color Groups 6 and 7 over Groups 1-5 in the Trash Mound. The sherds from Kiva 10 are predominantly Group 5. If a division of red from buff is made at Group 5 instead of 6 (as in Toll et al. 1980), 90 percent of the trachyte-tempered culinary from upper Kiva 10 is "red."

There is some question about whether the difference between Groups 5 and 6 is sufficient to indicate a clay-source shift, though it may; certainly, a larger refiring sample is necessary to be confident that even this change is real. The refired, trachyte-tempered sherds from Kin Kletso are very clearly different in that more than 60 percent fall into the buff Groups 1 to 3, an occurrence similar to the two earliest provenience groups (Table 1.15). The Kin Kletso sherds are so different as to be the stuff of flights of fancy. The ceramic assemblage from Kin Kletso (Vivian and Mathews 1965:65-73) is typologically very similar to that of Kiva 10, and more than half of the culinary sherds examined contained trachyte. The high frequency of buff-oxidizing, trachyte-tempered sherds is anomalous, as there is little reason to believe that Kin Kletso postdates Kiva 10 by much, if at all [Mesa Verde Black-on-white is not reported from Kin Kletso (see Vivian and Mathews 1965:65)]. Could this indicate separate site-by-site source areas? More likely it indicates the need for more work.

Windes (1977:293-294) points out that there is a significant difference between sand-tempered and trachyte-tempered grayware in both the CGP sample and a smaller one from Chaco Canyon; this difference is clear in the Pueblo Alto sherds as well. However, there is a significant difference between the CGP and the Chaco trachyte-tempered culinary sherds in Windes (1977:Table 10.6) as well ($X^2 = 20.5$, d.f. = 2, $p < .001$). Although all the sherds used in Windes' comparison are corrugated, the fact that around 30 percent of them came from Kin Kletso is relevant because its complexion is so distinctive. The sample from the Pueblo Alto Trash Mound, Booths 2-6, has a higher percentage in groups 6 and 7 than does Windes' CGP sample. If we take all trachyte-tempered grayware from Pueblo Alto (Table 1.44) and compare it with Windes' CGP, trachyte-tempered, cor-

rugated (1977:Table 10.6), the two are statistically similar. There is, then, a strong suggestion that primary clay sources within the Chuska Valley changed several times throughout the production span. Therefore, it is important to control for time in these comparisons, even within the indented corrugated vessel group.

Sandstones of various types all associate with predominantly light-firing clays, though the undifferentiated sandstone group is more variable in graywares than in carbon or mineral wares. As discussed below (Import section), Warren (1977) considers coarse-grained sandstone to be nonlocal in Chaco, and most of the grayware has coarse to very coarse temper (Table MF-1.39), so this clay variability may reflect a broader range of sources. Oxidation colors are equally distributed between coarse and very coarse sand grains in the Pueblo Alto sample. Windes' sample of sandstone-tempered graywares from the CGP Lease contains 50 percent red and yellowish red oxidizing sherds, which is much higher than the Pueblo Alto group or his sample from Chaco Canyon. In combination with the similar result in the mineral-painted sherds, it can be safely inferred that some sand tempering was practiced in the Chuska, which adds yet another complexity to an already difficult temper group. Franklin (1979) also found a preponderance of red-firing, grayware clays at the Salmon Ruin, though the predominant temper there is crushed andesite/diorite.

Refiring Color and Recorded Clay Attributes

Especially because of the large number of items that fall into no defined paste type, any apparent connection between pastes and oxidation color is tenuous here. Shepard (1956:17) shows that raw clays of various colors can fire to a wide range of other colors that overlap from one raw clay color to the next. As refiring is an attempt to equalize conditions to reveal something about raw clay source, the comparison of oxidation colors with fired clay colors is a minor demonstration of Shepard's point. In both white- and graywares, sherds that are white after original firing seem to be white after refiring (Table MF-1.44). Black clay appears to be more variable, and tan clay in this sample tends to be redder (recall that tan clay associates with trachyte temper). "Chuska gray" shows a surprising variability, especially considering its exclusive association with trachyte. This similarity of original firing result using different clays may indicate some consistency of firing practice in the area. The other most common paste type, gray body with white sherd temper, also refires to the whole color-group spectrum.

The effects of vitrification on oxidation color are also evident in Table MF-1.44. Five of eight "gray" oxidation colors are from sherds identified by inspection to be markedly vitrifed, and the other three gray items were coded as showing some vitrification. That apparently unvitrified sherds are, on the whole, light-firing probably relates to the association of the absence of vitrification and whitish clay sherds. This association may be the result of vitrification visibility on such sherds

or clay properties (higher vitrification temperature) or both. On the whole, the normal firing product, in which some sheen is apparent but in which vitrification is not advanced, usually does not affect refiring color.

Discussion, Speculation, Conclusions

Having examined at some length the attributes of the ceramics from Pueblo Alto, we can now step back and view them somewhat less minutely. What follows draws freely on all the foregoing sections of this report as a means of overview, synthesis, and placement of the Pueblo Alto ceramics in a broader context.

The reader is referred to the synthesis section at the end of the analysis of serial deposits for a review and interpretation of within-site trends and patterns. What remains is to examine Pueblo Alto vis-a-vis other sites and expectations of various models.

The Ceramic View of the Region from Pueblo Alto

Intraregion Production Variability

A major emphasis of the Chaco Project ceramic analysis has been an attempt to identify production areas as represented in the excavated sites. The picture of production that emerges from the Pueblo Alto ceramics is a complex one; it could be even more complex had we the keys to better understanding many attributes that are present in the sherds but inscrutable with the available analysis. Items containing some quantity of trachyte serve as an index of the variability probably present in other groups with less specific earmarks. A number of interacting variables give some idea of the complexity: design, as expressed in typological assignment on one level and in design elements at the next; paint; temper; form; and time.

Several constellations of these attributes occur in specific areas, and these have become established types when sufficiently abundant. Thus, there is a strong association of trachyte temper and carbon-painted whitewares in the Chuska area and another between mineral paint with sandstone and sherd temper in a fairly large area around Chaco Canyon. This sort of typological information is useful up to a point, but it is too coarse for examining intraregion production in detail. Closer inspection of the above attributes shows that there were more than two ways to make pottery, though potters were decidedly conforming to a lot of the same ideas. Conservatism in material use among potters is a standard assumption among archeologists (see Shepard 1956:164; Reina and Hill 1978:xx, 250-251). If that assumption is valid--as the above associations seem to indicate--then a number of subregional production areas may be tentatively identified.

In the Pueblo Alto ceramics there is a group of mineral-painted vessels with trachyte temper; the quantity of trachyte varies, and some of

these are probably accidental introductions of trachyte from sherd temper, but there are a number of reasons to believe that not all are (see the Type Descriptions section). Important reasons are the quantity of trachyte in some examples and the occurrence of such ceramics in the Chuska Valley. This group is different from Chuska carbons in that it is more likely to contain sherd temper than do its carbon-painted contemporaries. Within both Chuska paint groups, clay sources seem to vary in iron content, though the mineral-painted group tends to contain more low-iron (buff refiring) members than does the carbon group. Further, more red-oxidizing clays are found in sherds from this mineral paint group in the Chuska Valley than are found in Chaco Canyon. At the same time, greater use of squiggle hachure in trachyte-tempered than in other-tempered items suggests areal affiliation.

Thus, rather than monolithic types separated by clearcut boundaries, this somewhat finer examination suggests gradients in production tradition and multiple Chuska area producers. This does not necessarily preclude the existence of "specialized" potters, but it does make them seem likely to have been dispersed or not the only contributors to system ceramics. It is likely that similar gradients exist within the sandstone-tempering area.

There are several filters through which this view of regional ceramics has passed that add to the complexity of understanding them. The first of these is time--that is, is squiggle hachure a later development seen in trachyte-tempered sherds in Chaco Canyon because trachyte-tempering areas used that motif or because trachyte-tempering areas tended to supply the canyon later? The second filter may be vessel form--where ceramics of different areas are disproportionately represented by certain forms. As postulated by Whittlesey (1974), bowls are most often transported the longest distances. In Chaco all polished Forestdale-like vessels, all Tusayan whiteware, and most redwares of all areas are bowls. No graywares from similar distances, with the possible exception of San Juan igneous-tempered items, were recognized.

The San Juan and chalcedonic sandstone areas were low-frequency suppliers, but provided more varied forms--San Juan provided rare graywares and the southern (?) chalcedonic sandstone area predominantly graywares by the latter A.D. 1000s. Both the trachyte- and sandstone-temper groups include full ranges of forms, but there are also some vessel preferences within these groups (see previous section). Thus, distance may affect form occurrence, which may affect design, and so forth. The differences in clay source within trachyte-tempered culinary ware suggest that there may have been consuming-site/producing-area relationships and/or that source-area site locations moved through time, which adds yet another "filter."

Inter-region and Intra-region Design Similarity

Although some differences in intra-Chaco-Basin ceramics can be discerned, even within paint tradition, there are also remarkable similari-

ties across both paint and temper traditions. Plog (1980a), among others, has noted that in early (BMIII-PI), decorated, Anasazi ceramics there is a pan-regional design similarity and that this is followed by increasingly localized design traditions. This he attributes to membership identification of smaller, interacting areas. The design trends discussed by Plog do occur, but there are some different and additional perspectives that may be taken.

(1) On a pan-regional level, whereas areal traditions do begin to emerge in PII, it is still also true that the general period of most sherds is recognizable from their design across much of the Anasazi area. Thus, the counterpoint to Plog's argument is that the subtraditions show considerable continued similarity--if the subgroups were, in fact identifying themselves, they were by no means divorcing themselves from the rest of the Anasazi to do so. In addition to design evidence for this, there are actual pots from distant areas (not to mention other artifact design and architecture).

(2) On the Chaco region level, at least two easily recognized traditions--the Chuska carbon and the Cibola mineral--show very substantial interaction in ceramics. It may bolster Plog's case that much of the ceramic exchange was in grayware vessels, which, both intra-regionally and inter-regionally, are remarkable in their overall similarity from area to area, leaving, perhaps, whitewares to be symbolic.

(3) The use of hachure is extremely intriguing, and perhaps Plog's argument has some potential for understanding it. It has been noted that Gallup Black-on-white is the primary type in the Trash Mound, and it is suggested below that the Trash Mound is synonymous with the phenomenal part of the Chaco Phenomenon. It is also the case that hachure is very scarce on late carbon ceramics, which appear at the termination of Trash Mound deposition. There is, thus, a temptation to propose that hachure came to symbolize association with the system as a going concern. That hachure is as widely distributed as it is--it is, after all, "Dogoszhi Style," not "Gallup Style"--either dims or enhances the argument, depending on one's ambitions for the Chaco system.

(4) On an even more speculative and symbolic note, the carbon shift at the end of the Chaco Cibola series, as seen in Chaco McElmo, bears a definite similarity to Mesa Verde Black-on-white, which dates around 100 years later than Chaco McElmo. Although Chaco McElmo is different from Mesa Verde in several ways, a substantial portion of Chaco McElmo has several critical design features of Mesa Verde Black-on-white: square-ticked rims with bold solid lines concentric with the rim, all in carbon paint. It has been argued above that some Chaco McElmo is likely to have been produced in the Chuska Valley. The only pure Mesa Verde Black-on-white-style ceramics from Pueblo Alto are quite definitely from the Chuska area (also known as Crumbled House Black-on-white), which accords with findings elsewhere (Windes 1977; Franklin 1982) that Crumbled House predates Mesa Verde Black-on-white. On one level, then, it may be proposed that the direction and sequence of spread of this major design style may be discerned.

If that view is correct, on the next level it may be that the design style serves as an analog for the shifting center of population and interaction in the eastern Anasazi macro-region. It is becoming increasingly clear that most of the thirteenth-century, eastern Anasazi population was north of the San Juan River, but, especially if Plog's group identity through design has merit, this design development seems to indicate a continuity between the two areas and periods. The directionality suggested here is, of course, an oversimplification. The change to carbon paint took place in both the Mesa Verde and the Chaco regions at about the same time. On the one hand this simultaneity reinforces the close interrelationship of the two regions, but on the other it makes questions of directionality more difficult, if not moot. Only one thing is clear: all the McElmo Black-on-whites located around this shift to carbon paint in both time and space need intensive further study.

Ceramic Import to Pueblo Alto

Ever since Shepard (1939) identified trachyte in large quantities of ceramics from Pueblo Bonito, there has been controversy over and interest in imports to Chaco (see Judd 1954:234-238). The Chaco Project is centrally interested in import to Chaco and has obviously come down on Shepard's side by interpreting the quantities of trachyte (and other tempers) as signifying imported ceramics, and even going beyond her position in holding that some sherd-trachyte temper mixes are imports as well. Warren (1976, 1977) added new fuel to the discussion by asserting that, from very early in the Chaco sequence, 80-90 percent of ceramics were imports--of this, and reasons for suspecting quantities of import, more below. Briefly, because of clay tests, style, the scarcity of evidence for ceramic manufacture, and the lack of raw trachyte in any form in archeological contexts in Chaco Canyon, and because of the ethnographic distances for ceramic material acquisition found by Arnold (1980), we are quite certain that the trachyte and other exotic tempers were imported as pots, not raw materials (see Toll and McKenna 1981, 1982; Toll et al. 1980).

Table 1.47 presents an overview of ceramic import to Pueblo Alto through major time period. A number of assumptions and simplifications are necessary in compiling such a table. Vessels are considered imports if their temper is one of the four listed in the table--trachyte, chalcedonic sandstone, Socorro, or San Juan igneous, or if they can be identified as nonlocal from surface characteristics such as in the San Juan or Tusayan series. Socorro, taken from the type name Socorro Black-on-white, refers to a temper type here (black igneous specks, probably hornblende latite--see Sundt 1979). If an item is typologically exotic and has an exotic temper, it is listed in the table under the temper. The table is an attempt to include as many sherds as possible with as much temporal control as possible. Time assignments are made using both type and provenience; those items having types with temporal meaning are placed by type; those in "generic" types such as unidentified gray or whiteware, exotic mineral-on-white, Chuska whiteware of unspecified type, redware, or polished smudged are placed by means of the time assignment, provided that

Table 1.47. Summary of identifiable ceramic imports through time at Pueblo Alto.[a]

TIME (A.D.)/ Identification	Grayware n	Grayware % Import	Whiteware n	Whiteware % Import	Redware n	Redware % Import	Smudged n	Smudged % Import	Overall n	Overall % Import
920-1040/										
Trachyte	80	43.2	47	10.9					127	20.0
Chalcedonic SS	12	6.5	22	5.1					34	5.3
San Juan			6	1.4	6				12	1.9
Socorro			1	0.2					1	0.2
Typological			6	1.4	1		12	92.3	19	3.0
Total import	92	49.7	82	19.0	7	—	12	92.3	193	30.3
Total n	185		431		7		13		636	
Ware % of import		47.7		42.5		3.6		6.2		
Ware % of total		29.1		67.8		1.1		2.0		
1040-1100/										
Trachyte	470	55.2	254	19.5					724	32.3
Chalcedonic SS	56	6.6	28	2.2					84	3.8
San Juan	9	1.1	25	1.9	27	84.4			61	2.7
Socorro			1	0.1					1	0
Typological	1[b]	0.1	41	3.2	5	15.6	52	96.3	99	4.4
Total import	536	62.9	349	26.8	32		52	96.3	969	43.3
Total n	852		1,301		32		54		2,239	
Ware % of import		55.3		36.0		3.3		5.4		
Ware % of total		38.1		58.1		1.4		2.4		
1100-1200/										
Trachyte	121	53.8	141	27.8					262	32.0
Chalcedonic SS	8	3.6	3	0.6					11	1.3
San Juan	5	2.2	14	2.8	1	1.8			20	2.4
Socorro			2	0.4					2	0.2
Little Colo.			2	0.4					2	0.2
Typological	2[b]	0.9	46	9.1	54	98.2	32	100.0	134	16.3
Total import	136	60.4	208	40.8	55		32		431	52.6
Total n	225		508		55		32		820	
Ware % of import		31.6		48.3		12.8		7.4		
Ware % of total		27.4		62.0		6.7		3.9		
Unplaced Items										
Trachyte	29	42.0	8	20.0					37	30.8
San Juan			1	2.5	2				3	2.5
Socorro			1	2.5					1	0.8
Chalcedonic SS	2	2.9							2	1.7
Typological			10	25.0	7		2		19	15.0
Total import	31	44.9	20	50.0	9	—	2	—	62	50.8
Total n	69		40		9		2		120	
Ware % of import		50.0		32.3		14.5		3.2		
Ware % of total		57.5		33.3		7.5		1.7		
GRAND TOTALS										
Import	795		659		103		98		1,655	
Total n	1,331		2,280		103		101		3,815	
% import		59.7		28.9		100.0		97.0		43.4
Ware % of import		48.0		39.8		6.2		5.9		
Ware % of total		34.9		59.8		2.7		2.6		

[a]4 "mudwares" are not shown.

[b]Typologically identified "grayware" imports are brownwares.

the time segment is 100 years or less. A few specific types that span substantial portions of the table's time groups are also divided by the time assigned to the provenience from which they came.

It is possible to further control such time segment placements by excluding late types found in early proveniences (such as corrugated sherds found in pre-A.D. 920 deposits) as the obvious product of mixing. The ceramics left out of such an analysis are, thus, generic type sherds in broad time-segment proveniences. Of the total temper sample of 3,853, all but 158 (4.1 percent) appear in Table 1.47. The missing sherds are mostly from the A.D. 1020-1220 time segment; there are also a small number (0.5 percent of the total temper sample) of items placed typologically before A.D. 920, a few (0.3 percent) with unidentified tempers, and 1 percent that had no time or type placement. The time groupings shown in the table consist of the following.

A.D. 920-1020--The types included in this group are Early Red Mesa and Red Mesa Black-on-white, Chuska Carbon-on-white with Red Mesa design, narrow neckbanded, and neck corrugated. Items allocated by time group include both indented corrugated and plain gray, the plain and PII-III mineral whitewares, Chuska whiteware, redwares, and polished smudged. Note that the time group cuts off the last 20 years of the putative dates for the production of Red Mesa and puts those years with the subsequent time group. Thus, Red Mesa is separated in this table from items that are contemporaneous with it.

A.D. 1020-1120--All Escavada, Puerco, Gallup, the type Chuska Black-on-white, and all PII and PII-PIII indented corrugated are in this group. Plain and indented corrugated sherds from the correct time groups (A.D. 1020-1120 and A.D. 1020-1040) are included. The whitewares are again divided as above except that here the Chaco Black-on-white sherds are also included, as this type is thought to have been produced on both sides of A.D. 1120.

A.D. 1120-1220--The types included are the carbon-on-white types--PII-III carbon-on-white [which includes McElmo and what Franklin (1982) would call Cibola Carbon], Chaco McElmo, Tusayan whiteware, and Mesa Verde Black-on-white. PIII corrugated is the sole grayware type included, though, again, generic sherds of all wares except plain gray are placed by time segment. The rare polychrome sherds could have been placed typologically here, but they all were found in the "right" proveniences in terms of time assignment.

Entries in the table are calculated to show:

percentage import columns--the percentages of the total number of a given ware in a particular time group that are identifiable imports;

total import rows--again the percentages of the total ware in a time group that fits this definition of imported;

ware percentage of import rows--the n of imported wares divided by the total n of imports; and

ware percentage of total--the total n of each ware is divided by the total n of the time period; this is useful for comparing to the ware percentages of imports as a sort of expected value.

Time placements are from the project-wide, time-space matrix, which would be somewhat different were it to be established now. Use of this matrix, however, allows comparison with other sites that have been treated identically. All the whitewares typologically placed in the A.D. 1120-1220 group are carbon-on-white. Although the trend to carbon paint in late Cibola series ceramics is accepted, it should be noted that carbon paint is not in the Chaco tradition and that such vessels are more likely to be imports--any carbon-painted sherd found in a PII context in Chaco is automatically considered an import, for example, and several of the types assigned to this time period are also imports by definition (Tusayan). This factor can be seen in the substantially larger percentage formed by typological imports. It is likely that late Gallup and Puerco Black-on-white were produced after A.D. 1120, and vessels of these types are more likely than not to have temper attributes considered possibly local. Although this increase is in part "real" (see, for example, the higher percentage of trachyte in the whitewares), it is probably somewhat inflated by the partial exclusion of mineral-on-white ceramics.

Table 1.47 shows a conservative estimate of the level of ceramic import in several senses. The very abundant sand- and sand-and-sherd-tempered classes in both the graywares and whitewares are considered non-imports here, unless a whiteware item is identified typologically as an import. The class is so large and the use of these materials so widespread that, inevitably, there are vessels represented that were made at least as far from Alto as some of those with tempers signifying import. The sandstone-sherd temper class unquestionably includes ceramics from sites closer to the canyon than the Chuska Valley, but outside its central cluster of sites--the "Chaco Halo" (Marshall et al. 1982:1236-1239). Understanding goods movement from these areas is critical to understanding how the Chaco system really worked. Unfortunately, the widespread nature of clays and tempers in the area and our insufficient knowledge of details on material sources, production locations, and means of identifying pottery from these areas do not allow study of this shorter distance but all important import. Also excluded from import status are unidentified igneous and sandstone-trachyte mixes, portions of which are also likely to be imports.

All three of the time segments represented in Table 1.47 have sizable numbers of vessels--with the time and type caveats established in this report, the visible trends should have some reliability. The imported percentage of both gray- and whitewares increases from period to period, though at different rates. Graywares jump from 44 to 62 percent imported from A.D. 920-1020 to A.D. 1020-1120 and then level off to 64 percent, while the whitewares rise slowly at first (19 to 24 percent) and then show a sudden increase (24 to 46 percent). It must be acknowledged that "gray-

ware time" is not exactly equivalent to "whiteware time." For example, the deposits at Alto suggest that PII-PIII corrugated spans the turn of the eleventh to twelfth centuries, being more heavily weighted in what we are calling twelfth century deposits. Using the conventional date caused PII-III corrugated to be placed in the A.D. 1020-1120 segment, however, which separates it from Chaco McElmo with which it seems to go quite well.

Tusayan whiteware, placed in the latest group, also seems to cross the time segment boundary. Therefore, although it does seem probable that the increase in import occurred, the relative gray-white rates may have been smoother than those indicated here. These procedures also throw off the percentage of ware from period to period: the last period is slightly high on whiteware and low on grayware, but it will be recalled that, as a deposit, Kiva 10 leaned strongly in that direction. The small size of the Tusayan whiteware group means that the main distortion is in the graywares. The grayware problem, in particular, is lessened by splitting the large, unidentified, corrugated group by time segment.

In the graywares and the whitewares--and consequently in the overall counts--trachyte is the most abundant import temper in all three periods. Considerably less abundant but second in occurrence is chalcedonic sandstone, which shows an overall decline in frequency counterposing the increase in trachyte. As is true at other sites, the percentage of chalcedonic cement is nearly the same in gray- and whitewares in the A.D. 920-1020 time segment. In all subsequent time groups, chalcedonic cement is more common in graywares than in whitewares. In all time segments, grayware constitutes a higher percentage of the imports than it does of each whole time segment assemblage.

The high import percentage in the final period at Alto is, in part, a result of increases in relative frequencies of both redwares and polished smudged wares. San Juan tempers occur at slightly lower frequencies at Pueblo Alto than they do at other project sites. In our Chaco sample, San Juan whitewares show the greatest relative frequencies in the earliest (e.g., 29SJ 628) and latest (29SJ 633) assemblages, neither of which is present at Pueblo Alto. San Juan tempers take an upturn in the last period, in spite of the virtual absence of San Juan redwares in this period. The 3.1 percent San Juan igneous in the graywares in this period is high for graywares at all sites except 29SJ 633.

Comparisons of Pueblo Alto with other sites (Toll 1981, 1983) have indicated that the temper composition at Pueblo Alto is more diverse and more evenly distributed than it is at other sites. This result stems from having at least two major tempers--sandstone and trachyte--that are well represented, instead of heavy dominance by sandstone. Looking only at the imported component as shown in Table 1.47 provides an important qualifier for the comparison, however. If we treat the typological category as three categories--whiteware, redware, and polished smudged--and the tempers each as one category, the A.D. 1020-1120 period appears the least diverse of the four time segments at Pueblo Alto and, indeed, of all sites included in that period (Table MF-1.45). From A.D. 1040 to 1100 trachyte is the predominant temper in carbon-on-white and graywares and reaches its highest frequencies in the mineral-on-white types. The final period

appears the most diverse and even because of the large numbers in each of the typological subgroups.

This demonstration of the overwhelming importance of trachyte during the period when the Trash Mound was in use gives the apparent diversity a new dimension. Nonetheless, a broad-based ceramic supply is indicated, especially if the more-sandstone-than-trachyte group and the whitewares tempered with coarse sandstone are considered to each represent one or more nonlocal sources. Within thc confidently identifiable imports at this time, however, a single source area is overwhelmingly dominant. It has been shown in numerous ways that there is variability within that source area--clay types, temper mixtures, and paint types vary. Possible social explanations for this variability in ceramics from the Chuska area abound. It is quite conceivable, for example, that parts or all of communities from around the San Juan Basin periodically relocated in the Chuska Valley long enough to produce pottery there using the materials they found, but following their own decorative (mineral paint) practices. It is certainly likely that a resource rich area such as the Chuskas attracted people from a wide area, and the ceramics with trachyte temper suggest that such commingling took place. At the same time, there are also indications of cohesion within it--some design motifs associate with it, and variability among grayware jars is less than in other groups, for example.

In an attempt to squeeze some information out of the troublesome "undifferentiated sandstone" group, a grain-size breakdown of the items in the time groups in Table 1.47 is provided in Table 1.48. Coarse-grained sands are infrequent in Chaco Canyon and immediate environs, whether as free sand or in sandstone. Warren (1976, 1977) felt that coarse sand was sufficiently rare to assume that pottery tempered with coarse quartz was not made locally. Because some coarse quartz deposits have been located in the Canyon, and because sandstones containing coarse grains are present within Arnold's (1980:149) ethnographic catchment distance of 25 km or less for temper, this "grain-size assumption" is not reliable as an absolute. However, it is likely that much coarse-sand-tempered pottery found in Chaco Canyon was not made there. If such tempers signify non-canyon-made pottery, a different sort of import estimate is generated.

This estimate is a maximum of sorts, but still not a true maximum (none of the figures reach 100 percent). If all sandstone-trachyte were considered imported, the whiteware import percentages would be substantially raised. Further, among the fine-quartz-plus-sherd-tempered vessels are those that must have been produced over 30 km from Pueblo Alto. As the grain-size treatment is likely to include some local pots as imports, there is some balance. The maxima generated are, thus, in terms of what can be estimated from the available information.

With the grain-size assumption in effect (Table 1.48) nearly all of each time period's grayware shows as imported, culminating in 98.5 percent of the A.D. 1120-1220 segment. The assumption has considerably less effect on the whiteware of the periods represented at Pueblo Alto; it raises the import estimate only about 5 percent in the earlier and later periods but about 15 percent in the A.D. 1020-1120 group. If this is a

Table 1.48. Grain size of unidentified sandstone through time at Pueblo Alto and maximum identifiable import totals from Table 1.47, assuming coarse sandstone is not local.

TIME (A.D.)/ SS grain size	Grayware n	Grayware %[a]	Whiteware n	Whiteware %[a]	Smudged n	Smudged %[a]	Total Time n[b]	Overall Maximum Percent[c]
920-1040/								
Fine			80	26.1	6	50.0	86	
Medium	9	9.9	200	65.4	5	41.7	214	
Coarse	49	53.8	26	8.5	1	8.3	76	
Very Coarse	33	36.3					33	
Total	91		306		12		409	
Total C+VC	82		26		1		109	
Maximum import	174	94.1	108	25.1	13	100	302	47.5
Total n	185		431		13		636	
1040-1100/								
Fine	5	1.6	143	18.6	22	53.4	170	
Medium	20	6.4	448	58.1	17	41.5	485	
Coarse	145	46.6	173	22.4	2	4.9	320	
Very Coarse	141	45.3	7	0.9			148	
Total	311		771		41		1,133	
Total C+VC	286		180		2		468	
Maximum import	822	96.5	529	40.7	54	100	1437	64.2
Total n	852		1,301		54		2,239	
1100-1200/								
Fine	1	1.2	82	36.0	14	46.7	97	
Medium	16	18.4	104	45.6	16	53.3	136	
Coarse	33	37.9	40	17.5			73	
Very Coarse	37	42.5	2	0.9			39	
Total	87		228		30		345	
Total C+VC	70		42				112	
Maximum import	206	91.6	250	49.2	32	100	543	66.2
Total n	225		508		32		820	

[a]Column percents are within-ware within-time percentages of sand tempers.
[b]Total time n column adds redwares to both total and import rows.
[c]"Maximum percent" is the sum of all coarse to very coarse sand tempers and all identifiable imports (Table 1.24) divided by the total n of ware or time period.

reflection of source area, the source diversity in this time period is reinforced, counteracting the trachyte dominance found in the conservative import estimates. The larger jump found in the whitewares of this period redirects attention to Escavada Black-on-white as well as coarse-quartz-tempered Gallup and Puerco. Depositionally, this type spills into periods preceding and succeeding A.D. 1020-1120. It appears that it is primarily in the A.D. 1020-1120 group, however, that there is a substantial group of coarse-sand-tempered, mineral-on-white ceramics, which contrasts with the adjacent time periods. Escavada, then, may represent a production tradition. The terminal date now used for Escavada is A.D. 1100, but percentage of Escavada increases in the earliest carbon deposits, which are presumably later than A.D. 1100. Some perturbation in ceramic supply at this time has been suggested; such a ripple might have stimulated import or local production of this less well-made ceramic.

How Pueblo Alto compares with small sites in terms of import and vessel form assemblage is of much general interest because of the many speculations that have been made on the significance of the "town-village" split. A problem that has significance for far more than ceramics is the lack of fully contemporaneous small-site and large-site deposits. The site that comes closest to temporally overlapping Pueblo Alto is 29SJ 627; the heaviest use of 29SJ 627 antedates the heaviest use of Pueblo Alto, but the types found at 29SJ 627 indicate that something was going on at 29SJ 627 for much of the Pueblo Alto occupation. Although the predominant decorated type in the 29SJ 627 ceramic collection is Red Mesa, as opposed to Gallup at Pueblo Alto, the second-most-abundant decorated types at these two sites are Gallup and Red Mesa, respectively. The most abundant grayware type at both sites is PII corrugated. Moreover, several later types such as Tusayan whiteware, PIII corrugated, and Mesa Verde Black-on-white, occur at both sites in small percentages. The earlier emphasis is clear in the ceramics of 29SJ 627 and the later in Pueblo Alto.

Site 29SJ 633 also overlaps with Pueblo Alto, but tends to be later. The period with the best nominal overlap is A.D. 920-1020, from which 29SJ 629, 29SJ 1360, 19SJ 627, and Pueblo Alto all have sizable ceramic representation (Table 1.49). Once again, the contemporaneity is not precise--the three smaller sites were probably occupied for all of the period. Whereas Pueblo Alto is likely to be heavily weighted at the end of the period. Therefore, all comparisons must be made in terms of both time and site type.

Table 1.49 presents summary results from tables calculated for each site precisely as were Tables 1.47 and 1.48. The most striking thing about this table is the overall similarity from site to site. With only a slight tendency to higher levels of grayware import, Pueblo Alto seems to fit well in the trend visible in smaller sites. When the weighting toward later ceramics is considered in combination with the canyon trend, even the higher grayware import percentage may be more time- than site-related. If we compare only site-time groups with large samples and full treatment (the entries without footnotes in Table 1.49), Pueblo Alto does stand out for its grayware frequency and grayware import percentages, especially in the A.D. 1020-1120 time segment, as would be predicted from internal site findings. Apparent anomalies are present--the grayware precentage at 29SJ

Table 1.49. Comparison of percentages of import from five Chaco Canyon sites through time.[a]

Period/site	Total n	% Grayware	% Whiteware	CONSERVATIVE IMPORT ESTIMATES % GW Import[b]	% WW Import[b]	% Redware[c]	% Smudged[c]	GW + WW Import %	MAXIMUM OVERALL %
Pre-A.D. 920/									
Early[d]	2,496	53.5	37.1	6.2	11.5	5.1	4.3	8.4	80.8
29SJ 629	341	22.3	76.2	18.4	29.2	0.9	0.6	26.8	67.7
29SJ 1360	355	39.2	58.9	22.3	31.1	0.8	1.1	27.6	68.7
29SJ 627	649	49.8	48.7	20.1	19.1	0.9	-	20.0	74.0
Small[e]	1,349	40.0	58.6	20.4	25.8	0.9	0.4	23.6	71.2
A.D. 920-1040/									
29SJ 629	1,008	18.6	78.8	45.5	13.5	1.9	0.8	19.6	41.0
29SJ 1360	1,153	20.3	77.6	39.7	32.0	1.0	1.1	33.6	49.0
29SJ 627	4,832	17.6	80.1	36.7	17.9	1.5	0.6	21.2	44.7
29SJ 389	636	29.1	67.8	49.7	19.0	1.1	2.0	28.2	47.5
Small	7,012	18.3	79.5	38.5	19.1	1.5	0.7	22.7	59.8
A.D. 1040-1100/									
29SJ 627	787	40.2	59.8	38.0	21.9	-	-	29.6	61.6
29SJ 389	2,239	38.1	58.1	62.9	26.8	1.4	2.4	41.1	62.7
29SJ 633[f]	48	22.9	72.9	81.8	31.4	4.2	-	43.5	47.8
Small	883	38.3	61.5	43.5	23.0	0.2	-	30.9	61.5
A.D. 1100-1200/									
92SJ 627	286	50.0	50.0	39.9	58.7	-	-	49.3	77.6
29SJ 389	820	27.4	62.0	60.4	40.6	6.7	3.9	46.2	61.9
29SJ 633[g]	49	12.2	87.8	(50.0)	41.9	-	-	42.9	69.4
Small	424	40.1	59.0	42.9	50.8	0.9	-	47.6	71.9
A.D. 1200+/									
29SJ 633	151	24.1	68.5	46.2	51.4	7.4	-	50.0	60.0

[a]"Conservative" percentages are calculated from identifiable nonlocal tempers and types; "maximum" percentages add coarse-grained sandstone tempers to the conservative figures.
[b]Grayware and Whiteware Import are taken from the individual ware totals for each time period.
[c]Redware and % Smudged are taken from the total time period sample.
[d]"Early" is a combination of sites 29SJ 299, 423, 721, 724, 628, and 1659.
[e]"Small" is a combination of sites 29SJ 627, 629, 633, and 1360; all tabulations include added 627 culinary sherds.
[f]Note small n.
[g]Indicates groups that are placed strictly on typological basis, thereby excluding most redwares and polished smudged, and having sample size problems. Note small n.

627 in pre-A.D. 920 and the whiteware import levels for 29SJ 1360 in both A.D. 920-1020 and A.D. 1020-1120 (the latter is not a high-confidence group) are all high. The high percentage for A.D. 920-1020 at 29SJ 1360 results from higher-than-usual occurrences of both chalcedonic sandstone and San Juan igneous.

There is a tendency for small groups of sherds from terminal periods at sites to show sharp increases in import percentages (see 29SJ 1360 and 29SJ 629 gray- and whiteware in A.D. 1020-1120 and 29SJ 627 whiteware in A.D. 1120-1220). This may be due to the effects of typological time-segment placement, but it may also be speculated that circumstances leading to site abandonment might well disrupt procurement and/or production of pottery at a site.

The "maximum" estimates (as per Table 1.48) have a remarkably smooth aspect--within each time group, even regardless of sample size, the sites fall within around 11 percentage points. The two exceptions are 29SJ 627 segments. Because of changes in recording, all trachyte occurrences were treated the same, whereas at the other sites more sandstone than trachyte is not considered an import; this, plus the high grayware precentage in early 29SJ 627, increases its maximum import figures.

Distributions of identifiable imports follow consistent patterns within sites through time (Table MF-1.45). Basically, this pattern is one of high evenness import distribution in the pre-A.D. 920 group, followed by reduced diversity and evenness in the next period. The A.D. 1020-1120 period shows the least diversity and evenness, showing the dominance of trachyte. In the final period there is suggestion of return to the levels seen in the earliest period. Five of the six observable period-to-period trends for sites conform to this in both diversity and evenness, with only an increase in diversity from A.D. 920-1020 to A.D. 1020-1120.

In summary, the reliance on identifiably imported ceramics increases at all sites through time. Of the sites that can be confidently monitored, Pueblo Alto shows the highest percentages of imports, but the possibility that the higher percentages are partly temporal must be recognized. The diversity of sources represented is somewhat unclear because of the ill-definition of two of the largest temper groups, but coarse-grained-sandstone-tempered whiteware and abundant trace-trachyte-tempered whiteware suggest greater diversity than is immediately evident. As the latter is also abundant in the succeeding period, a decrease in diversity from Trash Mound to post-Trash Mound periods is not necessarily implied. As echoed in the Trash Mound lithics (Cameron, this volume), the link to the Chuska area is very strong and is probably critical to really understanding Pueblo Alto; at the same time, keep in mind that around half the ceramics are probably <u>not</u> from the Chuskas.

Because the increase in ceramic import is evident in smaller sites as well, and because it continues late at Pueblo Alto and at 29SJ 633, at least part of the import to the canyon seems readily attributable to need. As noted, with the exception of early sites and 29SJ 1360, very few Chaco Project sites produced evidence for manufacture; Judd (1954:184) remarks on the paucity of ceramic materials and tools at Pueblo Bonito. Ecologi-

cal arguments centering on fuel and moisture (Toll 1981:92-94; Warren 1976:55) have been made for reduced ceramic production in the central Chaco Basin. Because firing of ceramics consumes quantities of fuel--Colton (1951:74) records an average of 70 pounds of dung per Hopi firing--it may well have been efficient in terms of transport "cost" to import pots, especially large jars. The reduced variability noted in Chuskan culinary pots may also show some level of specialized production, especially if a year-round population of the canyon is assumed, along with the fuel depletion that was likely to have occurred (Samuels and Betancourt 1982). It is thus reasonable to expect substantial quantity of import to the canyon; the consideration of absolute quantities lends a new perspective to such import.

Quantity Estimates and Ceramic Consumption

Estimating the ceramic population at any site and then arriving at per-annum and per-family use rates is a procedure fraught with guessing, assuming, fudging, and leaping; at Pueblo Alto the degree of all of these is larger than usual. Two major reasons lie at the root of this exaggeration: the small relative amount of the site dug, and the greater-than-usual uncertainty as to the use and resident population of the site through time. Thus, we do not know how many other trash deposits there are nor are we really sure about the size of those from which we have samples. We cannot be sure how many people lived at Pueblo Alto in any given time nor do we know during how much of any given year or for how many years (e.g., Windes in Volume I, 1982, 1983). But educated guesses are possible, and the drive to try is greater than the fear of falling flat; moreover, these guesses and estimates are informative on questions of site population.

Given the problems, a step-by-step procedure of arriving at the estimates is preferable so that the reader may decide when the estimate has gone over the edge. Deposit size is critical here and must be projected in all of the major trash proveniences; the figures were generated as follows (see Table 1.50).

Early Trash Mound

The construction debris and earliest trash layers in the Trash Mound contain Red Mesa ceramics and are followed by an assemblage indicative of transition from Red Mesa to Gallup. As noted earlier, the first stratigraphic column was assigned to the Red Mesa century (labelled A.D. 920-1020) whereas adjacent deposits in the test trench were placed in the transitional A.D. 1020-1040 group. Because it is not now practicable to separate the two time periods in the Trash Mound (and perhaps fictional to do so), they are combined for purposes of this estimate. The volume estimate was derived by calculating the percentage of Test Trench 1 that falls in this time segment and generalizing that to the overall volume of the whole mound, calculated by Windes (1982b) to be 2,800 m^3. The method of inferring the composition of the rest of such a large feature from one

Table 1.50. Sample sizes, provenience sizes, excavation volumes and projected vessel quantities, Pueblo Alto.

Provenience[a]	Sample n		Size	Volume	Excavated		Projected n		Length	Pots per annum	
	decorated[b]	utility[c]	(m)	(m^3)	volume	%	decorated	utility	(A.D.)	decorated	utility
Red Mesa	252	116		871	18.9	2.2	11,454	5,273	1000-1040	286.4	131.8
Trash Mound	368									418.2	
Gallup Trash	2,000	1,313		1,613	35.5	2.2	90,509	59,682	1040-1100	1,515.2	994.7
Mound	3,313						150,591			2,509.8	
Kiva 13	47	24	r=4	125.7	3.9	3.1	1,529	781	1040-1100	25.5	13.0
	71		h=2.5				2,310			38.5	
Gallup Rooms	196	79				100	196	79			
103+110											
Kiva 16	162	74	r=2	8.2	2.6	31.8	509	233	1090-1120	17.0	7.8
trash layer	236		h=0.65				742			24.8	
Kiva 10 L 4	49	22	r=3.25,h=0.4	13.3	1.3	9.8	501	225			
above L 4	369	114	(r=4, h=2.3)+	125.6	10.2	8.1	4,544	1,404	1100-1170	64.9	20.5
			(r=3.25, h=0.3)								
Total Kiva 10	418	136	(r=4 h=2.3)+	138.8	11.5	8.3	5,036	1,639		71.9	23.4
	555		(r=3.25 h=0.7)				6,687			95.5	

[a]Excluded proveniences: lack of sample--Plaza feature, Rooms 112, 227, Rooms 143-147, 50-51, early Rooms 103, 110
lack of size estimate--Plaza Grid 8, wall clearing.

[b]White, red, polished smudged wares.

[c]Gray and brown wares.

trench is, of course, risky; Windes bolsters his case for doing so with Roberts' field notes on his trenches in the same mound, through examination of the ceramics collected by Roberts, and with inspection of the sherds and lithics on the surface of the Trash Mound.

Kiva 13

This is probably the most speculative projection because the least is known about this feature. Because it appears to be a large, deep kiva, Windes has estimated its dimensions from excavated Chaco Canyon kivas elsewhere in Chaco, especially Pueblo Bonito. The test in this kiva did not reach its floor; the maximum depth of the test was 1.8 m, with six fully excavated 20-cm levels.

Gallup Trash Mound

This is by far the largest deposit at the site. As in the case of the Red Mesa-Gallup transitional part of the mound, the percentage of the test trench in this category was projected to the whole mound. There are several alluvial layers at the southeast end of Test Trench 1 that contain a few later sherds. These layers and levels (including much of Booth 6) are placed in the project A.D. 1020-1220 time group and are excluded from the vessel estimates; the group used in these estimates, thus, is everything from the Trash Mound assigned to the project-wide A.D. 1020-1120 time segment.

The quantities dug from the Trash Mound come from the assessments made by McKenna in the field (Pueblo Alto Field Notes, page 35). Each grid-level unit is 0.3 m^3 (0.75 m wide by 2 m long by 0.20 m deep); not every grid-level unit is complete because of intersection with the sloping surface of the mound or the somewhat irregular base of the mound and trench. Grid-level units were assigned as wholes to time periods by Windes, regardless of the fact that all cut across strata, some of which are temporally different. McKenna measured the booth volumes, but those booths that had to be temporally subdivided (2 and 6) were entered in the volume sums according to estimates from the profile. The slumps and Test Trench 2 are not included in the final-analysis ceramic sample. These quantities were extensively reviewed with Cameron and Windes and are presented in Table MF-1.46 because of the difficulties in retrieving them without documentation.

In comparing these estimates with Cameron's estimated, chipped-stone figures from Pueblo Alto, it should be noted that her figures include the A.D. 1020-1040 group with the A.D. 1020-1120 group; this is a problem only in the Trash Mound, the only provenience placed in A.D. 1020-1040 at Pueblo Alto. This, and her inclusion of the slump material, mean that nearly the whole excavated sample from the Trash Mound is included in her one "Gallup" group (she excludes the A.D. 920-1020 part of Booth 1 and the "alluvial" portion of the mound).

Kiva 10

This large kiva associated with the North Roomblock was tested by means of a trench in the north half of the kiva. The trench nearly reached the floor, and the circumference of the structure was defined, allowing a close estimate of its dimensions. The calculation for the bottom layers takes into account the presence of the kiva bench; this unit slopes some, averaging about 0.4 m in thickness. This lowermost unit is ceramically distinctive from the majority of the kiva fill, and is placed in the pre-A.D. 1100 time segment. The kiva fill beneath wall fall, including both the dense trash that overlies the bottom layers and the bottom layers, is an average of around 3 m deep, with the thickness again varying across the structure. The volume of the trash unit is calculated as 2.3 m deep in the full 8-m diameter of the kiva, and 0.3 m deep below the top of the bench (radius = 3.25 m).

The Effects of Partial Excavaton on Ceramic Sample Representativeness

As can be seen in Table 1.50, the numbers in the estimates generated in this way are frankly alarming--it seems almost inconceivable that so many pots were disposed of at this one site. Several questions are raised by these results.

(1) How accurate is the vessel control of our sample? As discussed earlier, there is an overt attempt to control for matches and to avoid duplication. There probably are duplicates in our vessel count but they are unlikely to form a substantial percentage.

(2) What distortions can occur when translating from ceramic and excavation samples to population estimates? The final analysis sample is 6 percent of the bulk sherd count, which translates to an average of 16.8 sherds for every vessel in the sample, if one assumes perfect avoidance of vessel duplication. However, the ceramic sample does not come from the entire ceramic collection--the proveniences that are anywhere near fully represented comprise only 58.5 percent of the total bulk count (Tables 1.2, 1.3). Within the proveniences represented, the percentage comprised by the final-analysis sample ranges from 6.4 percent (west rooms) to 16.5 percent (Trash Mound booths), or 6 to 16 sherds per vessel; if we consider only rims, the percentage of the major proveniences is 7.7 percent (13 sherds).

In view of the fact that there are relatively few whole vessels at Pueblo Alto, any of these figures seems a bit low though they are similar to those for 29SJ 627 and 29SJ 629. Part of the reason for these low numbers of sherds per pot is that matched sherds count as one in the final analysis, whereas bulk counts count every sherd as one. These similarities to other sites do not verify the Pueblo Alto figures, but they indicate that comparisons are warranted.

The largest risks are, again, in estimating how much of given deposits were dug, especially in the Trash Mound. Dealing with small percentages and large samples means that slight changes in percentage estimates

translate into large differences in the size of the vessel estimate. Our attempt to arrive at an actual figure yields 2.2 percent of the Gallup portion excavated, which translates to 150,591 vessels, whereas if our sample were 10 percent of the Trash Mound, the estimate would be a mere 33,130 vessels. Because it is very unlikely that more than 10 percent of the Trash Mound was tested by this project, clearly there is a huge number of pots represented; the problem lies in determining how huge.

A further problem concerns the effects of partial excavation on the view of the population, even within single deposits. Orton (1980:162-164) illustrates that if two vessel types break differently and if strictly sherd counts are used, the relative frequencies of the two types will change depending on the percentage of the site dug. This illustration also assumes that vessel fragments are uniformly mixed and distributed. Orton's caution is valid, but we have several counteracting procedures and circumstances. First is the much-discussed rim sample with matching--if we worked at 100 percent efficacy, only vessels whose rims were encountered by the trench would be included in the detailed analysis; further, if more of the mound were dug, recovering more of vessels partially recovered should not increase the count.

Another pragmatic consideration, acting to help counteract failures in vessel control, is that although parts of a single vessel can be remarkably dispersed (Burgh 1959) (also see olla from Rooms 146-147, Plate 1.8b), the kind of dispersal and mixing necessary for Orton's example will not usually occur. Probably, then, a great deal of a deposit such as the Trash Mound would have to be excavated before new vessel representatives would drop off substantially. At the same time, it is possible that a trench may have a somewhat higher number of vessels represented by some rim fragments than the percentage excavated would suggest. Granted that the vessel control is reasonably good--a crucial assumption in this report--problems with vessel estimates seem to be mostly excavation problems: is a trench representative of a deposit and what percentage of the deposit does it constitute?

Having counted caveats, we can still say that the Trash Mound deposits at Pueblo Alto contain phenomenal numbers of vessels. Sheer numbers of vessels are impressive at 29SJ 629, 29SJ 1360, and 29SJ 627 as well, especially given our ethnocentric and archeological reverence for whole pots and the work they entail. Quite obviously, the prehistoric attitude was different--pots were there to be used and discarded when no longer serviceable, which was a regular event. At these sites projected estimates run from 7 to 28 vessels per family per year, with extremely conservative estimates of 6 to 11 on the basis of actual controlled sample size only (Table 1.51). The number of families living at Pueblo Alto is a subject of considerable speculation. Although Pueblo Alto has over 100 rooms, the project's excavations suggest that perhaps only a small number were habitation rooms. Two plaza-facing rooms in the West Wing (103 and 110) have all the features expected in a living room. None of the seven rooms excavated in the North Roomblock could be considered a standard habitation room (though some contain a few features), nor could either of

Table 1.51. Projected ceramic consumption rates for four Chaco sites, with detailed information provided for Pueblo Alto.

Site	% Excavated		Ceramic Vessel n		Projected	Years	Pots		Ppa/
	Rooms etc.	Midden	Rooms	Midden	Total	of use	per annum	Families	family
29SJ 629	100	70	922	750	1,993	130	15.3	2	7.7
29SJ 1360[a]	60	10	1,875	213	5,255	125	42.0	3	14.0
29SJ 627	90	10	5,539	1,299	19,144	225	85.1	3	28.4
Alto Red Mesa Trash Mnd.		2.2		368	16,727	40	418.2	20	20.9
Alto Gallup Trash Mnd.		2.2		3,313	150,590	60	2,509.8	20	125.5
Alto Gallup Rooms	10		275		2,750	60	45.8	20	2.3
Alto Gallup Kiva 13	3.1		71		2,290	60	38.2	20	1.9
Kiva 16	31.8		236		742	30	24.7	20?	1.2
Kiva 10	8.3		555		6,687	70	95.5	20?	4.8
Baseline[b]									
29SJ 629			1,707			130	13.1	2	6.6
29SJ 1360			2,088			125	16.7	3	5.6
29SJ 627			7,225			225	32.1	3	10.7
Alto Gallup Trash Mound			3,313			60	55.2	20	2.8
[a]McKenna's more elaborate estimates for 1360:			1,875	213	6,232	125	49.9	3	16.7

[b]Baseline figures use only the excavated, vessel-controlled sample from each site, with no allowance for unexcavated portions.

the rooms away from the plaza in the West Roomblock (112 and 229). If every plaza-facing room was a habitation room--which is unlikely given the excavated rooms in the North Roomblock--and none of the rooms away from the Plaza were habitation rooms, there could have been 20 habitation rooms at Pueblo Alto. Thus, an estimate of 20 families would seem to be somewhat high during the Gallup occupation; this generous estimate is used by Cameron (this Volume) in her lithic quantity estimates for the site and is also used here (Table 1.51). The occupation in the earlier site and later phases is even harder to gauge. We know little of the extent of earlier rooms at Pueblo Alto having excavated a portion of this occupation in Rooms 50-51 in the central roomblock. We know nearly nothing about the nature of the smaller, late rooms at the southwestern corner of the plaza as work on that section was confined to wall clearing. Later materials are found above the uppermost floors in the excavated rooms, so conceivably such rooms (and the Plaza Feature?) were all occupied. Perhaps 20 families "continued" to occupy the site.

Table 1.51 presents ceramic consumption projections from Pueblo Alto and other sites, and it is very clear that, if excavation estimates are anywhere vaguely near the mark, the numbers of pots at Pueblo Alto during the accumulation of the Trash Mound were completely out of proportion to those for the other sites. Lekson has pointed out that, in terms of per capita space at greathouses, there were either more people in rooms, or much more space for the people at Pueblo Alto. The same could be said for ceramics, but the projections as they stand are inordinate even if very many more people than are currently suspected were living there. How fewer people could go through so many pots requires a vivid and extravagant flight of fancy. This volume of ceramics seems an excellent reason to suspect that Pueblo Alto--and presumably other large Chaco Canyon sites--were the scenes of very large gatherings.

The apparent span of deposition in combination with the vast numbers of vessels tempts us further out on the speculative limb to suggest that a part of such convocations may have been containers full of something and that, perhaps as some form of renewal or of completion of a cycle, the vessels were destroyed. There are several facts that can be added to this fancy. As noted, there are some apparently intentionally destroyed bowls in the mound; there is a large number of grayware fragments in the mound (especially in "winter" layers--Ceramic Trends section); and Cameron notes that although the Trash Mound contains the highest percentage of Washington Pass chert of any project provenience, almost all of it appears to be unutilized.

The live-in population does not seem adequate to account for the quantity of pots projected (even if the estimate is divided by by 5 or 10, this statement still applies). If the contemporaneous deposits within the site were the places where the inhabitants placed their trash, then those projections show a low consumption rate. Probably some household trash went to the mound, and almost definitely there are some trash deposits in the house that are unknown to us, which would raise the quantities some, though there is still a long way to go before the 20 families reach yearly

per-family rates of other sites. The vessel assemblage in the Trash Mound does appear different from other deposits at the site--if there were large additions of ceramics by nonresidents, the heavy overlay would obscure the household deposits of residents. Blurring is increased because of the fact that the Trash Mound contains vessels that are drawn from Anasazi assemblages elsewhere--there is nothing to distinguish them other than the proportions and exceptional numbers in which they occur.

The estimates for the earlier portion of the Trash Mound are also large relative to other sites, though using the same 20-family estimate gives numbers falling in the same range as the small sites. We have no means of estimating the contemporaneous quantities in the site itself--there are Red Mesa materials in the undefined pit in Plaza Grid 8 and in west Plaza 1. In either the A.D. 1000-1040 period or the A.D. 1040-1100 period, then, the sherds in the Trash Mound are only a part of the ceramics deposited. The increase from the earlier to the main portions of the Trash Mound may be construed as the expansion of a practice that was established by A.D. 1040, or as a sequel to a phase of gathering for purposes of construction.

The deposits postdating the Trash Mound, Kivas 10 and 16, even when combined (Kiva 16 is in fact probably only partially contemporary with Kiva 10), show a very much lower consumption rate, if, once again, they are the main trash deposits from the last period. To produce a consumption rate of 15 pots per year per family, only around six to eight families would have been needed. This apparent drop in consumption seems to fit with the return to villagelike assemblage proposed (see Ceramic Trends section).

As Pueblo Alto as a whole has been found to have a lower diversity of vessel form than other sites (Toll 1981), lower diversity and evenness of form distribution is present in the Trash Mound compared with other sizable deposits at Pueblo Alto (Table 1.52). Although the high frequency of gray jars in the Trash Mound makes the two most common forms--gray jars and white bowls--more nearly even in the Trash Mound than elsewhere, the lower percentages of other forms in the Trash Mound lead to lower diversity and evenness of the mound assemblage. The projected numbers of less common forms are still very large, suggesting introduction through more than just household waste of a small population. However, the emphasis on whiteware bowls and especially grayware jars for this postulated special activity is clear.

Translating the estimates into identifiable imports during the Gallup portion of the Trash Mound, at least 49,270 trachyte-tempered pots were brought in and deposited (trachyte percentage from Table 1.28). If we take the trachyte-tempered grayware percentages from Booths 3-5 (52.5 percent, Table 1.32), this would have included 31,310 grayware jars, or 626 a year to Pueblo Alto alone. Examples of other quantities indicated are 3,834 chalcedonic-sandstone graywares (64 per year) or 1,738 San Juan igneous-tempered whitewares (29 per year). Once again credulity is strained, but remembering some other transport and other expenditures made during this period perhaps makes this seem less outlandish--Dean and

Table 1.52. Vessel form diversity and evenness in five Pueblo Alto proveniences.

	Early TM	Gallup TM	Kiva 10[a]	Rooms	Kiva 16
TS Group:	D+J	I	L	E+F	L
Number	368	3,306	487	274	236
Forms	10	14	13	13	13
Diversity	1.332	1.545	1.670	1.659	1.793
Evenness	0.579	0.586	0.651	0.647	0.699

[a]Upper layers only.

Warren (1983) project 200,000 trees cut and transported to the canyon for greathouses alone; this is probably when the roads were constructed (Kincaid et al. 1983), and this is when the major building boom occurred in Chaco Canyon (Lekson 1984a). The ceramics are, thus, another piece of evidence of a truly phenomenal period of activity.

Special Functions

Numerous functions for greathouse sites have been proposed, including apartment houses, dwellings for high-status individuals, storehouses, redistribution points, and combinations of these. With the exception of Pueblo Bonito, known primary-context ceramics from such sites do little to support any of these functions, especially during the high-activity, "classic" Chaco phase. As this condition is very much the case at Pueblo Alto, interpretations necessarily have an additional inferential aspect.

The ceramic characteristics of a redistribution point are not empirically known. Some attempts at generating possible expectations for such a site have been made--they include presence of specialized products, greater diversity of source area representation than at recipient sites, and greater quantity of imported goods (Fry 1980; Renfrew 1975; Toll 1981). If we consider mostly the period A.D. 1040-1100, all three of these expectations receive some support from the Pueblo Alto ceramics, though in no instance is the support unequivocal.

(1) Some metric and qualitative data suggest reduced variability in Chuskan grayware ceramics. Ethnographically it is not uncommon for only some individuals to produce ceramics, or only some villages, even under historic, "egalitarian" Pueblo conditions. Such producers are in a sense specialists, and no evidence can be adduced that the level of specialization in the Chaco region was any greater (Toll 1985). Furthermore, Pueblo Alto by no means had exclusive access to these products--the metrics, and to lesser extent the relative frequencies, of Chuskan graywares at small Chaco sites are very similar to those at Pueblo Alto. Specialists are a facet of redistributive systems as there must be some need for complementarity between producers of various types. The distribution of specialists' nonstatus products in an archeological record, however, is not necessarily controlled by the distribution point.

(2) The diversity of ceramic sources is discussed above under Import. Again, this index generally is somewhat higher at Pueblo Alto, which suggests better representation of different sources there than at smaller sites, perhaps indicating some falloff. But, with temporal considerations, the difference is not really large enough to attribute cultural significance to it.

(3) Relative quantities of imported ceramics, especially from the Chuskas, are higher than at 29SJ 627, but, again, some of the difference may have a temporal rather than functional basis. Absolute quantities of ceramics, on the other hand, appear to be what really separate Pueblo Alto from the other project sites. The presence in the Trash Mound of numbers

of ceramics out of all proportion to the apparent population and in assemblage proportions different from the smaller sites does indeed suggest a special site function. However, that so many pots were introduced into the archeological record at Pueblo Alto is antithetical to its having served to make pots available to surrounding sites. It is possibile that of the large number of vessels indicated, some imported ceramics were procured at Pueblo Alto by other-site residents, but relative to the cause of the deposition at the site, ceramic redistribution seems likely to have been minor.

One good reason to suspect that Pueblo Alto might have been a distribution point is its location at the focal point of numerous roads. Ceramics indicate contemporaneity of the roads and the Trash Mound, and exterior walls and road junctions spatially associate the two. The ceramics suggest that Pueblo Alto was at least a gathering point, but the nature of that gathering is not clear. This, then, seems to be a second dimension of ceramic consumption at Pueblo Alto and in Chaco Canyon: there was apparently an environmentally enhanced, domestic demand for nonlocal ceramics and, thus, more unusual consumption. That source proportions seem more or less the same suggests the same exterior groups were involved, perhaps in proportion to their population size.

"Town" Ceramic Assemblages and Pueblo Alto

Large-volume, ceramic consumption at Pueblo Alto and other towns might also be construed as evidence of status differentiation. The context of the ceramic remains does not lend itself well to the consideration of this interpretation. The forms and types found at Pueblo Alto are without exception also found at small sites.

Pueblo Bonito's extravagance of material has done a great deal to condition everyone's expectations of what items "should" be found in Chacoan "towns." The primary ceramic item in that set of expectations is the cylinder jar or vase, followed, perhaps, by the human-effigy vase. Such Pueblo Bonito expectations are not met by the ceramics recovered by the Chaco Project at Pueblo Alto. A single fragment of what could well have been a Gallup Black-on-white, cylinder jar was recovered from the Pueblo Alto Trash Mound. D.K. Washburn examined this sherd and thought it too large to be a cylinder jar, but our estimated diameter of 14 cm falls at the upper end of the 8.8-14.9-cm range of those found at Pueblo Bonito by Judd (1954:372-373).

After recovering one cylinder jar sherd in four seasons of careful excavations, we are disturbed to note that Martin and Willis (1940:152-153) show two intact cylinder jars from Pueblo Alto in the Field Museum collection. That the catalogue provenience is probably incorrect is revealed in a letter dated November 15, 1904, from the Wetherill Mercantile Company to Dr. George Dorsey, which states:

> There are two Ceremonial Jars such as Pepper got in Room 28 at Pueblo Bonita [sic]. These were found by Manuel Maestes, a Mexican in a burial mound near Pueblo Alto...

The letter goes on to offer the collection of which these are a part for examination with intent to sell. The cylinder jars in Martin and Willis (1940) were accessioned by the Field Museum on February 16, 1905, so there is little doubt that they are the same vessels. Judd (1954:210) also mentions these jars.

A host of frustrating speculations is raised by these two jars. What did Wetherill mean by "burial mound"? Could it be the Trash Mound? A small house mound near the Escavada? New Alto? Certainly, burials are in short supply "near Alto" as far as we know, but "burial mound" probably covered a multitude of site types (not to mention promulgated a multitude of sins). The Pueblo Alto Trash Mound seems a good candidate, except for the fact that the Chaco Project recovered not one complete and intact vessel from it.

A search of the literature postdating the Pueblo Bonito expeditions indicates that Judd's (1954:210-214) inventory of known cylinder jars needs little addition to be current (Table 1.53). As Judd points out, the overwhelming majority of cylinder jars come from Pueblo Bonito and from a very few rooms (see Judd 1959:156). More than half of the known cylinder jars come from Room 28 at Pueblo Bonito, and 80 percent come from seven rooms in its central portion. Burials are associated with some of the cylinder jars, especially those from the West Wing; whether or not they were grave goods is unclear, however, because most of the burials are disturbed and the humans far outnumber the cylinder jars (about 83 to 19; see Toll 1986).

There seem to be two reasonable explanations for this extremely restricted occurrence of this form.

(1) Pueblo Bonito had some unique function that involved cylinder jars. The quantity and variety of unusual materials from Pueblo Bonito, its size, and its central location all make this position tenable. The rare occurrences of cylinder jar fragments elsewhere--11 that can be considered possibly contemporary with some vague provenience--can perhaps be dismissed as extensions from the Bonito base. The two cylinder jars from the mysterious "near Pueblo Alto" provenience, for example, can be speculatively attributed to a road-related feature. If they were town ceremonial items, surely some would have been found at extensively excavated Chetro Ketl, in the painted wood rooms, for example (Vivian et al. 1978), but none are known (Lekson and McKenna 1983).

(2) Alternatively, cylinder jars, indeed being special, will always be found highly localized within sites as they are at Pueblo Bonito. Perhaps they were associated with burials, and similar contexts have not been encountered (though the 111 in Room 28, as Judd notes, do seem to have been stockpiled). Such an argument is eminently feasible at Pueblo Alto with its large numbers of unexcavated rooms and for most other large

Table 1.53. Proveniences of PIII or earlier Anasazi cylinder jars.

Provenience	n	Reference
Pueblo Bonito		
Central Block--Room 28 cache	111	Pepper 1920
Room 39B	19	Ibid.
Room 52/32	20	Ibid.
Other central rooms	17	Judd 1954; Pepper 1920
East Block	5	Judd 1954; Pepper 1920
West Block	18	Judd 1954; Pepper 1920
Front Rooms	2	Pepper 1920
Pueblo Bonito Subtotal	192	
Pueblo Alto--Trash Mound	1	this report
"Near Pueblo Alto"	2	Martin & Willis 1940
Pueblo del Arroyo--Room 15	4[a]	Judd 1959
Tri-wall	1	Stabilization
Trash	1	Windes, p.c. 1981
29SJ 1360	1	McKenna and Toll 1984
Bis sa'ani Community Site 31	1	Franklin 1982
Manuelito? (San Diego Museum of Man)	1	Windes, p.c. 1981
Piedra District--PI?	1	Roberts 1930:107
Navajo Reservoir District	2	Eddy 1966
? Santa Fe Museum--PII?	1	Judd 1954: 210
Non-Bonito subtotal	16	
Total	208	

[a]3 polished red.

sites. Following this line, Pueblo del Arroyo, the second-most fully excavated, large site, has the second-most number of cylinder jars. The "stray" examples under this interpretation indicate that cylinder jars are present at other sites, but that nobody has hit the right room.

Which of these explanations one believes is strictly a matter of choice. We are inclined to think that enough disturbance has occurred in the canyon that more jars would have been found were they not rather strictly limited to Pueblo Bonito.

One final note should be made on this localization of cylinder jars. Very few have been examined even megascopically, but it is clear that a substantial percentage are carbon-painted. Those few carbon-on-white that we (Windes, McKenna, Toll) have had the opportunity to handle are clearly trachyte-tempered and have Chuskan slips. Moreover, several mineral-on-white cylinder jars on loan to the Maxwell Museum from the American Museum of Natural History (Pepper's collection) appear to us also to be trachyte-tempered. These trachyte-tempered cylinder jars imply that a highly specialized form was made in a remote location and then transported to Pueblo Bonito but apparently to nowhere else. This, in turn, suggests a special relationship between potter and consumer. Further, there were numerous potters certainly capable of producing this form, which presumably had a special connotation, but apparently there was some form of control that prevented proliferation of this form. The speculation could be taken much further, but it has nearly left the realm of ceramics already.

No census of Anasazi human-effigy forms like those found at Pueblo Bonito (Judd 1954:224-227; Pepper 1906) has been made, but it is probable that even fewer of this form have been found than of cylinder jars, at least in Anasazi contexts of PIII age or earlier. Once again, the majority are from Pueblo Bonito. Judd reports finding parts of 41, Pepper "several" (at least 5) more from Bonito, a fragment from Peñasco Blanco, and Putnam a whole example from an unknown "grave" site in the canyon. Franklin (1980:561; 1982:48-54) reports a head from Salmon and one from the Bis sa'ani Community (found in an arroyo!). Judd points out that the Pueblo Bonito examples were found in numerous deposit types, as were the few other examples.

Human-effigy vessels of this distinctive sort are not present in the Pueblo Alto collection. As their distribution at Pueblo Bonito is apparently broader than that of cylinder vessels, perhaps the chances of Chaco Project excavations enountering one were greater. Still, their known frequency is even less than cylinder jars, and a larger sample from Pueblo Alto might have included one--the question of whether or not this is a more-or-less Pueblo Bonito-specific form remains open.

Two human effigies were found at Pueblo Alto, but of a very different type from those described by Pepper, Judd, and Franklin. In a floor pit in Room 110, a habitation room in the West Roomblock, was a copulating couple. The figures are made of unfired, sandy adobe with charcoal features (eyes, etc.). They were quite clearly not intended for firing--nei-

ther the material nor the ornamentation would have survived it. Although charming in their own way, they show no signs of having been produced by a potter--what they are and what they are doing is unmistakable, but they lack the anatomical detail and formality of the Pueblo Bonito and Putnam specimens.

Ceramic animal effigies are present but uncommon at Pueblo Alto, and most (all?) are incorporated into vessels as handles or in relief on the sides of pitchers; these include two frogs or toads (one handle, one pitcher) and the leg of some unidentified animal (pitcher--see Appendix MF-1.A, F.S. 6717-8 and 6505, Kiva 10). A bird's head is also present on a restorable duck pot from Floor 2 of Room 145 (Plate 1.1). No large deer or antelope (?) effigies (see Judd 1954:219-220) were recovered from Pueblo Alto. Because at least four heads from such vessels were recovered from Bc 51, these seem less big-site- or Bonito-related.

Concluding Ceramic Scenario

As a finale, one interpretation of Pueblo Alto's place in the Chaco system from a ceramic perspective is presented. It is offered as a basis for further refinements.

Pueblo Alto fits very much into the period of intense activity in the late tenth and eleventh centuries in Chaco Canyon. Planning is one of the hallmarks of the Chaco system, and, from its inception or shortly thereafter, Pueblo Alto shows signs of having been part of the plan. By the time the Trash Mound was begun, during construction of the Main Roomblock, there are suggestions of the two aspects to the site's ceramics, a domestic one and one that is somewhat different as expressed in the Trash Mound.

In the construction phase the difference as we know it is minor, but with the commencement of the accumulation of nonconstruction debris--which, interestingly enough, coincides fairly well with the commencement of Gallup Black-on-white as the most abundant decorated type--this difference becomes more evident. During the relatively short span of deposition of this later part of the Trash Mound--something like A.D. 1040-1100--there was a nearly incredible consumption of energy in Chaco Canyon and at Pueblo Alto as indicated by construction and ceramics, among other things. It is of great importance to the understanding of Pueblo Alto's place in the canyon, that the apparently massive deposition in the Trash Mound was contemporaneous with building peaks in the canyon (Lekson 1984), but that building was apparently not taking place at Pueblo Alto itself.

Pueblo Alto, then, was an established site and may well have functioned in mobilizing large numbers of people to participate in construction at other central canyon sites. It has been proposed here that the ceramic consumption at Pueblo Alto far outweighed the population of the site and that the imbalance indicates a special site function. The ceramics involved with this function are drawn from a fairly standard San Juan

Basin type and temper assemblage, though there is a marked emphasis on Chuskan graywares.

The whitewares of this period have a variety of pastes, but the great majority fit into the mineral-paint, Cibola tradition in design. If, once again, such traditions identify interacting groups (as per Plog 1980a), the area with which Chaco Canyon seems to be affiliated is predominantly the southern San Juan Basin (more or less south of the Escavada and Chaco Washes). Importantly, some potters in the Chuska area produced whiteware ceramics fitting this description. Also notable is that there are mineral-on-white ceramics from the north and carbon-on-white from the Chuskas and farther west, all of which presumably would have been recognizable as non-Chaco Cibola. To this must be added clearly nonlocal red and polished smudged wares to form a considerable minority group of nonlocal items. Although the symbolic significance of the assemblage must remain speculative, the focus to the south and west at this time is unambiguous.

No clear ceramic evidence of high status or of ceremonial significance exists at Pueblo Alto--the prime distinguishing characteristic of the Pueblo Alto ceramics is their great volume, mostly derived from the Trash Mound. Though the diversity of ceramic forms is less in the Trash Mound than in other sites or other parts of Alto, there is still a variety of forms in the Trash Mound. The relative frequency of gray jars is higher in the Trash Mound than in other proveniences. Akins (1982) has suggested that there is faunal evidence for feasting in the Trash Mound, and the ceramics perhaps fit with that suggestion. It can be proposed, then, that large gatherings of unknown nature occurred with some regularity over this period.

Although some ceramics may have changed hands at these functions, many were broken and remained at Pueblo Alto. This evidence is as close as we can come now to suggesting redistribution, i.e., through the assembly of large numbers of people (see Ford 1972). The ceramics do not directly show either how or what might have been redistributed. When we consider that ceramic and trash volumes are at least equivalent at Peñasco Blanco and greater at Chetro Ketl and Pueblo Bonito, to mention only the immediate and obvious trash mound examples (see Volume II, Table 8.14 and Trash Mound discussion), the scale of ceramic consumption by central Chaco Canyon as a whole becomes even more staggering.

Another shift in deposition and ceramic decoration seems to parallel a system shift at around A.D. 1100, when Trash Mound deposition at Pueblo Alto ceased. All our evidence points to a greatly reduced consumption and a return from the grayware emphasis of the Trash Mound to patterns seen elsewhere. At this time non-Chuskan, carbon-painted ceramics rapidly increased in frequency. I would suggest that these changes and the reduction in construction activity (also with a change in style) signal the termination of the economic adaptation begun in the A.D. 900s and operated at full scale in the second half of the A.D. 1000s. There are a number of noteworthy things about the late ceramics at Pueblo Alto. They are typologically similar to a number of outliers, most notably northern ones: Salmon, Aztec, Bis sa'ani (Franklin 1980, 1982), and to in-canyon "McElmo"

sites such as Kin Kletso (Vivian and Mathews 1965) and to Pueblo del Arroyo's main complement (Judd 1959).

Cursory perusal of surface ceramics from outliers south of Chaco (Marshall et al. 1979; Powers et al. 1983) suggests very little occurrence of carbon-painted ceramics at these sites, though some very late ceramics are present (e.g., St. Johns Polychrome). This absence may be due either to time or to ceramic source for these southern sites; they seem to correspond very superficially to the Trash Mound and earlier portions of Pueblo Alto. This circumstance and, more important, the closeness of the better-known, northern outliers to the late Pueblo Alto ceramic assemblage pose some crucial questions.

From early in the Chaco Project, Pueblo Alto was postulated as likely to have some northern affiliation, both because of its location in the central-canyon, large-site group and because of the convergence of northern roads in the Pueblo Alto East Plaza. The ceramics in Kiva 10 might suggest support for that affiliation, but similar ceramics also occur at many other central-canyon sites. The most perplexing question raised by these circumstances is the apparent lack of synchronization between Pueblo Alto as a fully functioning Chaco Canyon town and the northern outliers to which it is linked by road. If our date of A.D. 1100 for the beginning of Chaco McElmo is correct, there is an overlap between the terminal Trash Mound and the construction of Salmon and Chimney Rock around A.D. 1090. However, Bis sa'ani and Pierre's date to the A.D. 1120s and A.D. 1130s, and seem clearly post-Alto Trash Mound (see also Toll 1985).

Preliminarily, then, it seems likely that the period in which Pueblo Alto participated on large scale with the system was in the eleventh century with strong focus to the west and the south. It may still have had that role early in the northward expansion of the system, but its role, or at least the ceramic, lithic, and architectural manifestation thereof, changed soon after.

Pueblo Alto continued to be used while the northern outliers were, but there was only a minor increase in the occurrence of ceramics indentifiably from as far north as the San Juan River. Architecturally, it may be inferred that Pueblo Alto continued to serve some specialized function: the plaza feature, the circular structure, several "other structures," and large, exterior firepits probably all come from this late period. Ceramically, however, the assemblage appears to have returned to a more nearly "normal" habitation assemblage in composition and number. Use of Pueblo Alto as a habitation by this apparently fairly small population probably lasted until the latter half of the A.D. 1100s. There can also be little doubt that a large site located on a road nexus retained some significance even after it ceased to function as a part of the system. The ceramics--and even the archaeomagnetic dates--suggest that virtually all use of the site had ceased by A.D. 1200.

In sum, then, from the viewpoint of ceramics but infringing on many other classes of information, Pueblo Alto seems to have been a site entirely tied to the operation of the system. Its inception corresponds

with the early part of the meat of the Chaco "classic." Its location can better be understood in terms of system requirements--roads and view--than in terms of subsistence. Most of its use coincides with the maximum activity in the canyon, and its decline seems to coincide with the scaling down of that activity. Having had its entire raison d'etre removed with the failure of the system, it is perhaps not surprising that it fell into complete disuse before the other large sites in the canyon bottom.

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Chapter Two

Chipped Stone from Pueblo Alto

Catherine M. Cameron

Introduction

Excavations at Pueblo Alto produced a total of 12,338 pieces of chipped stone. Change in material selection, chipped stone technology, and tool function is examined for the 200-year occupation of the site. Examination of regional resource exploitation emphasizes the identification of sources of raw material (Table 2.1). Technological and functional variation was examined with the use of tool and flake types described below.

The Sample

During four seasons of field work at Pueblo Alto (1976-1979), approximately one-tenth of the site was excavated, including 12 percent of the roomblock and 2.6 percent of the trash mound (Windes Volume I of this report). Almost one-third of the chipped stone recovered from the site was from the Trash Mound. Very little was from primary context.

Chipped stone recovered during the 1976, 1978, and 1979 seasons was analyzed using the 10X stereoscopic microscope to identify artifact type. In 1977, identifications were made without the microscope. This created some problems in subsequent analysis. Twenty-six percent of the assemblage from the 1976, 1978, and 1979 seasons was identified as utilized or retouched flakes, whereas only 15 percent of the assemblage from the 1977 season was identified as utilized or retouched flakes. A Chi-square test (Table 2.2) of artifact type by year of excavation was significant at .001. In addition, one artifact category, "whole flakes", was not identified during the 1977 field season. To correct discrepancies in the analysis, utilized and retouched flakes will be considered separately by year of excavation, and whole flakes will be combined with angular debris.

Table 2.1. Material type groups.

Material Type	Warren's Type Numbers Included	Total	%
Morrison Formation[a]	1020, 1022, 1040, 2201, 2205	443	3.6
Yellow-Brown Spotted Chert[a]	1072	142	1.2
Washington Pass Chert[a]	1080, 1081	2,472	20.1
Zuni Silicified Wood[a]	1160, 1161	291	2.4
Obsidian[a]	3500-3640	348	2.8
High Surface Chert	1050-1054	830	6.7
Cherty Silicified Wood	1112, 1113	1,594	12.9
Splintery Silicified Wood	1109, 1110	1,966	15.9
Chalcedonic Silicified Wood	1140-1145	1,626	13.2
Quartzite	4000, 4005	789	6.4
Others	All other material types[b]	1,827	14.8
Totals		12,338	100.0

[a]Exotic material types.
[b]Other material types:
1010,1011,1012,1014,1021,1030,1035,1041,1042,1044,1060,1061,1070,1075,1090,1091,1100,1111,1120,1130,1131,1150,1151,1152,1153,1170,1200,1210,1212,1214,1215,1220,1221,1230,1231,1232,1233,1234,1235,1240,1300,1310,1320,1330,1400,1411,1430,1551,1570,1600,1610,1650,1660,2000,2020,2200,2202,2204,2209,2220,2221,2250,2500,2550,2551,2650,2700,2710,2919,3015,3100,3150,3300,3700,4009,4010,4053,4060,4375,5000,5010.

Table 2.2. Artifact type by year of excavation.

	Year of Excavation		
Artifact Type	1977	1976,1978,1979	Total
Tools	815 (1,087)	1,099 (826)	1,914
Debitage	4,401 (4,128)	2,868 (3,140)	7,269
Total	5,216	3,967	

$X^2 = 199.9$
df = 1
Prob. > .001

( ) = Expected frequencies

Definitions of artifact types and core types are given below.

Type No.	Definition
200-239	See Lekson (1979)
241	Utilized flake: any piece that exhibits edge damage due to use.
242	Retouched flake: any piece that exhibits intentional retouch (distinguished from use-wear by size and regularity of flakes) on one or more edges, that does not extend more than one-third of the way across the face of the object.
243	Whole flake: a flake exhibiting a platform, a bulb of percussion and full distal end.
249	Angular debris: a piece exhibiting no positive bulb of percussion, or less than two negative bulbs of percussion, and with the remains of flake production evident: portions of flake-scars, ripple marks, etc.
251	Core: a piece of material that does not exhibit a bulb of percussion and from which two or more flakes, 2 cm or more in length, have been removed.
299	Other chipped stone: any piece showing either facial or edge modification and which does not fit into one of the formal tool categories.
770	Raw material: pieces of siliceous stone that show no signs of use or manufacture, but are large enough to permit flake production or tool manufacture.

Core Types (see Cameron 1982)

1	Irregular core: flakes are removed from several surfaces in any available direction. Shape is blocky.
2	Discoidal core: flakes removed in two directions from the edge, resulting in a disc-shaped core.
3	Polyhedral core: flakes removed from one platform in a systematic fashion, resulting in a cone-shaped core.
6	Wedge-like core: a rectangular piece of material with flakes emanating from both ends, resulting in a wedge shape.

Method

Chipped stone was initially classified by artifact type and material type. Presence or absence of cortex was noted. Within each provenience, artifacts of each type were grouped by material type and weighed by lots.

Artifact types included formal tools, retouched flakes, utilized flakes, unutilized whole flakes, angular debris, cores, and unmodified raw material (Table 2.3). Further analysis of formal tools was undertaken by Lekson (1979). His analytic categories are included here.

Cores were subjected to further analysis (Cameron 1982) and core types assigned during that analysis are used here. Because of the vagaries of the Chaco Center storage procedures, not all cores could be found for further analysis, so some cores have remained untyped.

Material types were developed by Warren (n.d.). In this analysis, Warren's types are combined into five exotic and six local groups (Table 2.1). Exotic materials are defined as those with sources farther than 10 km from Chaco Canyon. For a detailed discussion of analytic procedures, see Cameron (1982).

Spatial and Temporal Systematics

Excavation units that produced chipped stone were combined by Windes (Volume I of this report) into 166 provenience groups (Table MF-2.33). These provenience groups form the basic analytic units for the present analysis.

One hundred thirty-four provenience groups, contributing 93 percent of the chipped stone, could be assigned to one of three major temporal phases identified at Pueblo Alto (Windes, Volume I of this report; Toll and McKenna this volume). These phases are labeled by the major ceramic type that defines them. At Pueblo Alto, these periods are best dated as follows:

Red Mesa phase (A.D. 1000-1050),
Gallup phase (A.D. 1050-1100), and
Late-Mix phase (A.D. 1100-1150).

The remaining 33 proveniences, from intermediate or unknown time periods, generally contain very low frequencies of chipped stone and will not be discussed further here. Detailed data for all provenience groups is on file at the Branch of Cultural Research, Southwest Regional Office, National Park Service, Albuquerque, New Mexico.

Several of Windes' original proveniences were reformulated during this analysis. Provenience group 19 contained all floor features from Floor 1 of Room 110. This group was subdivided to reflect the three, separate, floor surfaces that made up Floor 1. Strat Columns in the Trash Mound (lithic proveniences 130, 137, 138, 139, and 140) were regrouped by stratigraphic layer into three temporal divisions within the Gallup phase

Table 2.3. Artifact types.

Type Number	Tool Type	Total
203	Corner-notched projectile point	16
204	Side-notched projectile point	45
206	Corner-notched projectile point blade fragment	15
207	Side-notched projectile point blade fragment	12
208	Large-shouldered projectile point	1
209	Miscellaneous blade fragment	12
210	Large nonhafted blade	4
211	Side-scraper	2
213	Small nonhafted blade	1
214	Asymmetrical/irregular projectile point	1
215	Large corner-notched projectile point	1
218	Renotched side-notched projectile point	1
221	Knife	2
223	Saw	1
231	Formal drill	4
233	Gouge/chisel	1
234	Informal perforator	6
235	Projection on a flake	4
241	Utilized flake	2,243
242	Retouched flake	240
243	Whole flake	1,373
249	Angular debris	7,601
251	Core	118
299	Other/unknown tool	3
770	Raw material	621

Trash Mound. Table MF-2.34 lists field specimen numbers associated with each of these new groups.

Windes (Volume I of this report) defined four depositional types at Pueblo Alto: construction debris, intentional fill, household debris, and Trash Mound debris. Construction debris resulted from site construction. Intentional fill, found primarily in the central roomblock, was introduced into rooms after construction to raise room floor levels before plastering. Household debris represents trash generated by everyday activities during site occupation. In contrast, Windes (Volume I of this report) notes that the Trash Mound at Pueblo Alto was deposited intermittently and lacks firepit ash. He feels, therefore, that it is not typical household debris and may be the result of both construction activity and other nondomestic activities.

The Analysis

Use of Proveniences

In this analysis, the proveniences in Table MF-2.33 are combined into groups based on location within the site, depositional type, and temporal assignment (Table 2.4). Not all areas and depositional types are represented in each temporal unit. Chipped stone from the Red Mesa phase is found primarily in the north of the site and in the Trash Mound; Gallup phase chipped stone is primarily from the west of the site and the Trash Mound; Late Mix phase chipped stone is found in the north, west, and east of the site and in trash-filled, plaza kivas. Therefore, the framework used for grouping proveniences differs somewhat between time periods.

Analytic Methods

The following sections examine artifact-type and material-type variability within each of the three major temporal periods. For each period, provenience groups are described and material type frequencies compared across provenience groups. Where chipped stone totals are large, specific excavation units (Room 110, Trash Mound, etc.) are examined in more detail.

An index used in the examination of artifact-type variability is a ratio of tools (formal tools, utilized, and retouched flakes) to all chipped stone. This ratio provides a rough method for comparing function among proveniences: a high ratio (i.e., a large number of tools) could indicate tool use activities, whereas a low ratio (denoting a larger proportion of debitage) could suggest raw material reduction or tool manufacturing activities. Proveniences are separated by year of excavation to correct for the different methods of analysis used in 1976, 1977, 1978, and 1979. As might be expected, the ratio for 1977 proveniences is generally lower than in other years, ranging from 0.10 to 0.34. Ratios for

Table 2.4. Provenience groupings used in analysis.

Group Number and Description	Lithic Proveniences Included (See Table MF-2.33)
Red Mesa Phase	
1 Construction Debris	1977: 38,61; 1978: 44,49,63,65,165
2 Household Debris	1977: 98,99; 1978: 92,94,95,96
3 Trash Mound	1977: 127,133,134,135,136
4 Intentional Fill	1977: 60; 1978: 2,34,39,42,43,45,50,51,
5 Miscellaneous Red Mesa	1977: 6,105,112,113,115,116
	1978: 21,30,71,74,54,109,150
Gallup Phase	
6 Room 103, Floor 2	1977: 5,12
7 Room 103, Floor 3	1977: 8,13
8 Room 103, Floor 4	1977: 9,15
9 Room 110, Layer 1,2	1978: 20,22
10 Room 110, Floor 1, Surfaces 1-3	(see Table MF-2.2)
11 Room 110, Floor 1, Surfaces 4-6	(see Table MF-2.2)
12 Room 110, Floor 1, Surfaces 7-9	(see Table MF-2.2)
13 Trash Mound, Early	(see Table MF-2.2)
14 Trash Mound, Middle	(see Table MF-2.2)
15 Trash Mound, Late	(see Table MF-2.2)
16 Kiva 13	1977: 106
17 Plaza 2	1977: 166 (FS#'s<3488)
	1978: 166 (FS#'s<3488)
18 Miscellaneous Gallup	1977: 10,100,156,163
	1978: 11,26,27,155,32,69,70,73,53,57,81
Late Mix Phase	
19 West Wing Wall Fall	1977: 84; 1978: 3,28,72
20 West Wing Roof Fall	1977: 17,85; 1978: 4,29
21 West Wing Room Fill	1977: 16,18,68; 1976: 7
22 North Wing Roof Fall	1977: 36,40,64; 1978: 33,55,59,66
23 West Plaza Kivas	1977: 87
24 North Plaza Kivas	1978: 80
25 East Plaza Kivas	1977: 82,142,83
26 West Plaza	1977: 103; 1976: 89
27 East Plaza	1977: 102,107,108
28 Plaza 2	1977: 162 (FS#'s <3489)
	1978: 162 (FS#'s >3489)
29 Plaza Feature 1	1977: 151,153; 1978: 149,154
30 Other Structures 4 and 6	1977: 146; 1976: 144
31 Miscellaneous Late Mix	1977: 35,41,46,88,131,160,161,157,143
	1978: 52,58,67,68,77,75,147,148,117,78

proveniences excavated in 1976, 1978, and 1979 ranged from 0.10 to 0.47. Measurable functional differences do exist among provenience groups.

Finally, variability in formal tools and cores is examined within each time period, incorporating data from other analyses (Cameron 1982; Lekson 1979) when appropriate.

The Red Mesa Phase

Provenience Groups

Most of the provenience groups assigned to the Red Mesa phase were the lowest levels of the North Roomblock, the plaza area adjacent to the North Roomblock, and the western portion of the Trash Mound. Two-thirds of these provenience groups could be assigned to one of the four depositional types (Table 2.4): chipped stone associated with construction debris was found on the lowest floors of Rooms 139, 142, 146, and the North Trench; chipped stone associated with intentional fill was found in subfloor areas of Rooms 50, 51, 138, 139, and 142; chipped stone associated with household debris was found in Plaza Grid 8 and in a large pit (Other Pit 1) in Plaza Grid 30. Trash Mound debris assigned to the Red Mesa phase was found in Strat Column 1, Strat Column 2, and lower levels of the backhoe trenches.

Material Type Variability

In the four depositional types found in the Red Mesa phase (Tables MF-2.1 through MF-2.6), local silicified woods are the predominant material type; in all proveniences, the most common exotic material is Washington Pass chert. Household debris shows the greatest variation from the other depositional types with more than 50 percent chalcedonic silicified wood, compared to less than 20 percent for other depositional types. The Trash Mound has the highest frequency of exotic materials (21 percent), especially Washington Pass chert, whereas other depositional types have less than 10 percent exotic materials. Almost half of the chipped stone from intentional fill is of "other" material; other depositional types have less than 25 percent "other" material.

Although Windes (Volume II of this report) feels that much of the Trash Mound debris and intentional fill from the Red Mesa phase is associated with site construction and therefore should be similar to construction debris deposits, chipped-stone material frequencies do not support similarities between these depositional types. A Chi-square test of grouped material (exotics, cherty silicified wood, chalcedonic silicified wood, others) by depositional type (for construction debris, Trash Mound debris, and intentional fill) was significant (X^2 = 70.8 prob > 0.001), indicating variability in the types of chipped-stone material associated with these deposits. Based on raw material frequencies, Trash Mound

debris, intentional fill, and construction debris do not seem to represent overlapping depositional types.

Trash Mound proveniences assigned to the Red Mesa phase can be divided into two groups (Tables MF-2.3 and MF-2.4), one from the western edge of the Trash Mound (proveniences 127, 134, 135) and the second from the interior (proveniences 133 and 136). Interior proveniences have far more exotic material than those on the edge of the Trash Mound. A Chi-square test of material type by Trash Mound location was significant ($X^2 = 27.2$, df = 3, prob > .001). This may be a result of mixing of the interior provenience material with the later Gallup phase material that predominates in the Trash Mound. The Gallup phase has a much greater frequency of exotic material than does the Red Mesa phase (see Gallup Phase below).

As noted above, almost half of the material from intentional fill (Table MF-2.5) was "other" material. Most of this "other" material was from a single lithic provenience (No. 60: Room 139/145, fill between Floor 1 and Floor 2) and was coded as "raw material." It was accompanied by a large number of small pebbles that were not included in the chipped stone analysis. Much of the raw material was coarse grained (miscellaneous silicified wood, miscellaneous quartzitic sandstone, and material of indeterminate, but undoubtedly local, origin) and may not, in fact, be associated with chipped-stone processing. Raw material from this provenience will not be considered in the remainder of the discussion. (Table 2.5 presents material frequencies for intentional fill with raw material from lithic provenience 60 removed).

Artifact Type Variability

The ratio of tools (formal tools, utilized, and retouched flakes) to all chipped stone is high in construction debris (0.38) and low in household debris (0.12) for those proveniences excavated in 1976 and 1978 (when the material was examined with a microscope (Table 2.6). Construction debris and household debris excavated in 1977, however, have similar ratios (construction debris = 0.18; household debris = 0.20).

Excavation units are different between the two seasons. Construction debris excavated in 1977 is primarily from Room 139, whereas construction debris excavated in 1978 is primarily from Rooms 142 and 146. Based on the ratios, tool-use activities are suggested for these deposits in Rooms 142 and 146. Windes (Volume II of this report) notes that deposits in these rooms were all accompanied by quantities of sandstone spalls, which were clearly the result of wall construction of these rooms. Tools in these proveniences represent the construction process. Differences in analytic technique are probably masking a high ratio in Room 139, as these three rooms form a functional unit.

Household debris in 1977 is entirely from Other Pit 1 (OP 1) of Plaza Grid 30, whereas household debris in 1978 is from Plaza Grid 8. Low tool

Table 2.5. Red Mesa phase: material frequencies of intentional fill without raw material from provenience 60.

	n	%
Morrison Formation	2	1.24
Washington Pass Chert	6	3.72
Zuni Silicified Wood	1	0.62
Obsidian	2	1.24
High Surface Chert	27	16.77
Cherty Silicified Wood	44	27.33
Splintery Silicified Wood	7	4.34
Chalcedonic Silicified Wood	38	23.60
Quartzite	9	5.59
Other Material	25	15.53
Total	161	
%		100.00

Table 2.6. Red Mesa phase: ratio of tools to all chipped stone.

Provenience	1977	1978
Construction Debris	0.18	0.38
Household Debris	0.20	0.12
Trash Mound	0.10	
Intentional Fill		0.22

ratios suggest reduction or tool-manufacturing activities for deposits in Plaza Grid 8. However, interpretations of OP 1 of Plaza Grid 30 are more ambiguous. In spite of the difference in analytic technique, tool ratios are higher in OP 1 of Plaza Grid 30 than in Plaza 8. This suggests functional differences between these two proveniences.

The portion of the Trash Mound assigned to the Red Mesa phase was excavated only in 1977. It had a much lower tool ratio (0.10) than did other proveniences excavated in 1977 (Table 2.6) which suggests the deposition of the remains of raw-material reduction in the Trash Mound, rather than trash representing tool use.

Almost all intentional fill deposits were excavated in 1978. The ratio of tools to debitage for this depositional type was intermediate compared to other 1978 proveniences (Table 2.6). This may be the result of mixing of deposits of other types in production of intentional fill.

Comparisons With Other Sites

Red Mesa phase household debris (Table MF-2.2), concentrated in Plaza Grid 8 and OP 1 of Plaza Grid 30 can be compared with chipped stone material found in a contemporary large plaza pit at site 29SJ 629 (Cameron 1980). The plaza pit at 29SJ 629 contained numerous tiny fragments of turquoise, broken or partially manufactured beads, and many tiny drills, mostly of chalcedonic silicified wood. In fact, both areas contained high frequencies of chalcedonic silicified wood. Both may have been associated with bead-working activities. The plaza areas at Pueblo Alto produced fragments of turquoise (two were beads) and a large number of black stone beads (Mathien 1984), but no drills like those at 29SJ 629 were recovered.

However, tool ratios suggest some differences between the two areas. Although the tool ratio for OP 1 of Plaza Grid 30 at Pueblo Alto was relatively high (0.20, Table 2.6), the tool ratio at Plaza Pit 1 at 29SJ 629 was almost twice as high (0.39) (Cameron 1980). These contrasting ratios could be a result of different analytic techniques (material from OP 1 at Pueblo Alto was not examined with a microscope, whereas material from Plaza Pit 1 at 29SJ 629 was examined with a microscope) or they might suggest different discard patterns between the trash deposits at these two sites.

Formal Tools

Of 15 tools from Red Mesa proveniences, all but 2 are projectile points (Table 2.7). Seven are corner-notched projectile points (or fragments), five are side-notched projectile points (or fragments), and one is a large-shouldered point. Although the sample is small, it is notable that these projectile point types are found in roughly similar proportions from A.D. 920-1020 at other sites in Chaco Canyon (Cameron 1982).

Table 2.7. Red Mesa phase: formal tools by material type.[a]

	203	204	206	207	208	209	211	Total	%
Wash. Pass	1		2					3	20.0
Obsidian		2		2		1		5	33.3
High Surf.	2	1						3	20.0
Quartzite							1	1	6.7
Others	2				1			3	20.0
Total	5	3	2	2	1	1	1	15	
%	33.3	20.0	13.3	13.3	6.7	6.7	6.7		100.0

[a]203 = corner-notched projectile point
204 = side-notched projectile point
206 = corner-notched projectile point blade fragment
207 = side-notched projectile point blade fragment
208 = large-shouldered projectile point
209 = miscellaneous blade fragments
211 = side scraper

Eight tools are of exotic material (Washington Pass chert and obsidian). Interestingly, exotic materials seem to be type-specific: side-notched projectile points are obsidian, whereas corner-notched projectile points are Washington Pass chert. These exotic tools represent four of the five tools of Red Hill obsidian and three of the five tools of Washington Pass chert found at Pueblo Alto.

Although the sample is again small, the use of exotic material for formal tools contrasts with the contemporary debitage, which is mainly local materials, especially silicified wood. No formal tools of silicified wood were found in Red Mesa phase proveniences. Although one-third of the formal tools from the Red Mesa phase were of obsidian, only seven flakes of obsidian were found from this time period. This suggests that at least some tools were not manufactured at the site, but were introduced in a finished state.

Formal tools were distributed fairly evenly throughout the four depositional types (Tables MF-2.1 through MF-2.6), and there was no obvious pattern to the occurrence of tool types within proveniences.

Cores

Of the 12 cores from Red Mesa proveniences, 7 were found in the trash mound, 2 in intentional fill, and 1 each in household debris, construction debris, and miscellaneous proveniences (Tables MF-2.1 through MF-2.6). All were of local material (Table 2.8), and eight of these were of silicified wood. Most were irregular in type (n = 8).

Although debitage of chalcedonic silicified wood was common in most Red Mesa proveniences, only two cores of this material were recovered. This may be due to the form in which the material occurs. Chalcedonic silicified wood is found in log form at some distance from the canyon, and processing large pieces of this material would not necessarily result in easily recognizable cores (Cameron 1982; Love 1982).

Gallup Phase

Provenience Groups

Proveniences assigned to the Gallup phase were concentrated in the West Roomblock and in the Trash Mound (Table 2.4), which contained 80 percent of the chipped stone from this phase. Gallup phase material from Room 110 constituted the only large quantity of primary context material found at the site. Other areas with large samples of Gallup phase chipped stone were Kiva 13 and Plaza 2.

Rooms 103 and 110 are considered habitation rooms (Windes, Volume I of this report), and most of the deposits found in these rooms represent

Table 2.8. Red Mesa phase: core type by material type.

	Irregular	Discoidal	Wedge	Untyped	Total	%
Cherty Silicified Wood	5		1		6	50.0
Chalcedonic Silicified Wood	1		1		2	16.6
Quartzite	1				1	8.3
Other Material	1	1		1	3	25.0
Total	8	1	2	1	12	
%	66.6	8.3	16.6	8.3		100.0

household debris. Deposits in Kiva 13 and Plaza 2 are also considered household debris, although Windes feels that debris in Plaza 2 is unlike household debris in other parts of the site.

Layers 1 and 2 of Room 110 were limited to intentional fill introduced after the room was abandoned, during construction of Kiva 15. No construction debris was associated with the Gallup phase.

Material Type Variability

Chipped stone material during the Gallup phase is characterized by large quantities of Washington Pass chert and splintery silicified wood (Tables MF-2.7 through MF-2.19). Other exotic materials are also relatively common, except for obsidian. The percentage of raw material varies among proveniences. To summarize, Room 110 has the highest frequency of exotic material, and the Trash Mound also has a high frequency of exotic material and a high frequency of splintery silicified wood. Exotic materials in Room 103, Kiva 13 and Plaza 2 were less frequent, although Plaza 2 had an unusually high frequency of obsidian.

The following sections provide a detailed examination of material type variability within the three major excavation areas that make up the Gallup phase: Room 110, Room 103, and the Trash Mound.

Room 110. Room 110 was a plaza-facing room during the Gallup phase. Fill (Layers 1 and 2) above floor levels contained Gallup phase trash, used as intentional fill during later remodeling. Raw materials were primarily splintery silicified wood, chalcedonic silicified wood, and Washington Pass chert (Table MF-2.10). Fill layers contained fewer exotic materials than did other Room 110 proveniences.

Floor 1 of Room 110 had the largest quantity of primary-context, chipped stone found at Pueblo Alto (Tables MF-2.11 through MF-2.13). Floor 1 had 9 distinguishable surfaces and 170 features. Sixty-six features contained chipped stone. Other than feature associations, chipped stone was infrequent on Floor 1 surfaces. The most common features found on Floor 1 surfaces were "other pits," which are holes of varying size and shape. Large, deep pits produced the greatest quantities of chipped stone. These may have been trash pits while the floor was in use (Windes, Volume II of this report), as they contained a variety of cultural debris, including coprolites.

Floor 1 pits contained large amounts of Washington Pass chert, Zuni chert, and splintery silicified wood. There were indications that some of the flakes found in Floor 1 pits were the result of a limited number of chipping episodes; in some cases, flakes could be matched with cores from which they originated.

A test of ubiquity was used to examine relative numbers of chipping episodes represented by flakes within floor pits. This procedure records

the percentage of pits in which a material type occurred (Table 2.9). Washington Pass chert occurs in the largest number of pits, which suggests that the distribution of this material was the result of several chipping episodes. In contrast, almost all Zuni wood is found in a single pit (OP 60, described below), suggesting a single episode. Several coarse-grained materials (splintery silicified wood, quartzite, and miscellaneous quartzitic sandstone) were also found in a relatively large number of pits, whereas other material types occurred in very few pits.

Other Pit 39 and OP 60 on Floor 1 are unusual (Table 2.10). Other Pit 39 contained many large flakes (average flake weight 4.22) of coarse-grained material (quartzite, quartzitic sandstone, and splintery silicified wood) and little other material. Flakes found in OP 39 may be the result of activities involving coarse-grained material, such as hammerstone manufacture or use, or ground stone manufacture or maintenance.

Other Pit 60 contained many tiny flakes of Zuni wood (average flake weight 0.14), a few flakes of splintery silicified wood, and an antler flaker. As noted above, chipped stone in OP 60 is probably the result of a single chipping episode.

No formal tools were associated with Floor 1; however, seven cores were recovered. Five of these were of Washington Pass chert and one of Zuni wood (Tables MF-2.11 through MF-2.13).

Very little chipped stone was associated with a series of mealing bins at the southern end of the room, but activities associated with the mealing bins may have resulted in deposition of chipped stone elsewhere in the room. A large number of hammerstones, primarily of silicified wood (14 of 18), were associated with the mealing bins (Windes, Volume I of this report), and production and/or use of these hammerstones may have produced the large quantities of splintery silicified wood found in Floor 1.

Chipped stone, especially Washington Pass chert and Zuni wood, clearly was being reduced in Room 110, at least during portions of the occupation of the room. The high frequency of coarse-grained materials, especially splintery silicified wood, may be associated with the use of hammerstones in corn-processing (mealing) activities that have been suggested for the room.

Room 103. Like Room 110, Room 103 was a plaza-facing room during the Gallup phase, and has been interpreted as a habitation room (Windes, Volume I of this report). However, compared with Room 110, chipped stone was less frequent; 181 flakes were associated with the Gallup phase (Tables MF-2.7 through MF-2.9). Excavated proveniences consisted of five floors with associated floor fill. None of the material associated with these floors was considered primary context material.

Most exotic materials were less frequent in Room 103 than in Room 110, except for Morrison formation material. As elsewhere, local material was primarily splintery silicified wood, cherty silicified wood, and

Table 2.9. Gallup phase: Room 110, Floor 1.
Ubiquity of material types within floor features.

Material Type	% of Features in which Material Occurs
Washington Pass	60.3
Zuni Sil. Wood	4.8
High Surf.	7.9
Cherty Wood	6.3
Splintery Wood	25.4
Chalcedonic Wood	7.9
Quartzite	12.7

Table 2.10. Gallup phase: Room 110, Floor 1.
Material frequency for "Other Pits" No. 39 and No. 60.

Material Type	Other Pit 39		Other Pit 60	
	n	%	n	%
Washington Pass	2	3.4	1	0.8
Zuni Sil. Wood			105	86.8
Cherty Sil. Wood			1	0.8
Splintery Wood	4	6.9	14	11.6
Quartzite	21	36.2		
Quartzitic Sandstone	27	46.5		
Limestone	4	6.9		
Totals	58	100.0	121	100.0

chalcedonic silicified wood. "Other" material was also common, although one-third was classified as raw material, much of which could not be identified by material type (all associated with floor fill of Floor 3). Raw material is excluded in the following discussion.

Floors 1 and 5 contained almost no chipped stone (Floor 1, n = 15, Floor 5, n = 3) and will not be considered further. Floor and floor fill material were combined for each of Floors 2 through 4. Although totals were low, percentages of material types appear to vary between floors (Table MF-2.7 through MF-2.9). Exotic materials were relatively infrequent on floors 2 and 3 but more common on Floor 4. Splintery silicified wood was the most frequent local type found on Floor 2, whereas cherty silicified wood was the most common local type on Floor 4. Floor 3 had almost equal distributions of both of these local materials. "Other" material was relatively common on all three floors.

Floors 2 and 3 of Room 103 can be equated temporally with surfaces 5 and 6 of Room 110, and Floor 4 of Room 103 can be equated with surfaces 7 and 9 of Room 110 (Windes, Volume II of this report). Although presumably contemporaneously occupied, these two rooms had different chipped-stone-material frequencies. Floors 2 and 3 of Room 103 had far less Washington Pass chert, and more cherty and chalcendonic silicified wood, than did surfaces 5 and 6 of Room 110. Compared to surfaces 7 and 9 of Room 110, Floor 4 of Room 103 had higher frequencies of Morrison formation material and cherty silicified wood; however, percentages of Washington Pass chert were similar between the two proveniences. The emphasis on reduction of exotic material found in Room 110 does not seem to be present in Room 103.

<u>Trash Mound</u>. The Trash Mound at Pueblo Alto produced most of the chipped stone found at the site, and most of this material has been dated to the Gallup phase. The most common material types from Gallup phase deposits in the Trash Mound are Washington Pass chert and splintery silicified wood (Tables MF-2.14 through MF-2.16).

Trash mound excavation units were combined into three stratigraphic groups, which constituted early, middle, and late periods of deposition within Gallup phase deposits of the Trash Mound (Tables MF-2.14 through MF-2.16). Although percentages of most materials were fairly constant during these three subperiods, Washington Pass chert tends to decrease through time (from 40 percent to 20 percent of the assemblage) whereas splintery silicified wood correspondingly increases (from 7 percent to 31 percent of the assemblage). This shift in material frequency may indicate a shift in activities at the site. In Room 110, splintery silicified wood appeared to be associated with hammerstone use. High frequencies of this material in the Trash Mound may indicate an increase in such activities as hammerstone manufacture or use, perhaps as a subset of construction activities or ground-stone manufacture or maintenance. On the other hand, decreasing frequencies of Washington Pass chert may indicate less frequent contact with the source of this material in the Chuska Mountains.

Other Proveniences. Of the other proveniences dating to the Gallup phase, only Kiva 13 and Plaza 2 contained significant quantities of chipped stone.

Chipped stone was recovered from trash deposits in Kiva 13 (Table MF-2.17). As in other Gallup phase proveniences, percentages of Washington Pass chert and splintery silicified wood were high, although the percentage of Washington Pass chert was lower than in most Gallup proveniences. Percentages of Morrison formation material were greater than in other Gallup phase assemblages.

In contrast, Plaza 2 had a very low frequency of splintery silicified wood, and Washington Pass chert was less frequent than in other Gallup proveniences. However, obsidian was relatively frequent (Table MF-2.18). These material frequencies are more similar to those found in the Late Mix phase than in the Gallup phase.

Artifact Type Variability

Room 103, Kiva 13, portions of Plaza 2, and portions of the Trash Mound were excavated in 1977; all other Gallup phase proveniences were excavated in 1978. The ratio of formal tools, utilized, and retouched flakes to all chipped stone is separated by year of excavation (Table 2.11). Because chipped stone totals were low on floors in Rooms 103 and 110, ratios were constructed for combined floor surfaces. Ratios for the Trash Mound include only material from the 1978 season when microscopic examination was used.

Of the proveniences excavated in 1977, Room 103 and Plaza 2 have low tool ratios, while Kiva 13 has a high tool ratio. Based on tool ratios, raw-material-reducation activities might be suggested for Room 103 and Plaza 2, whereas deposits in Kiva 13 may represent tool-use activities.

Of the proveniences excavated in 1978, Floor 1 of Room 110 has the highest tool ratio (Table 2.11), and all tools are utilized or retouched flakes (no formal tools were recovered). Although, previous evidence (see Gallup Phase, Room 110 above) has suggested that Room 110 was used, at least occasionally, for raw material reduction, high tool ratios also suggest tool-use activities in the room, as would be expected in a habitation room.

Over 40 percent of the utilized and retouched flakes from Floor 1 of Room 110 are Washington Pass chert, compared with 24 percent Washington Pass chert for debitage, (one-third of the Washington Pass chert flakes are utilized or retouched). This suggests a preference for Washington Pass chert in tool-use activities; although on further examination (see below), this suggestion was not supported. Many other utilized and retouched flakes are of quartzite and splintery silicified wood (primarily flakes showing battering wear, indicating that they were detached from a hammerstone), which would support the suggestion that these materials

Table 2.11. Gallup phase: ratio of tools to all chipped stone.

Provenience	1977	1978
Room 103	0.14	
Room 110, Layers 1,2		0.22
Room 110 (Floor 1 ??)		0.24
Trash Mound Early		0.10
Trash Mound Middle		0.22
Trash Mound Late		0.16
Kiva 13	0.24	
Plaza 2	0.12	0.22

Table 2.12. Gallup phase: proveniences excavated in 1978 (except Plaza 2). Comparison of exotic and local material by artifact type.

	Tools	Debitage	Total
Exotic	159 (138.5)	497 (517.5)	656
Local	217 (237.5)	908 (887.5)	1,125
Totals	376	1,405	1,781

$X^2 = 6.08$
df = 1
Prob. >.02<.01

( ) = expected values

represent hammerstone activities that have been previously described in this room.

Of the three temporal divisions of the Trash Mound, the earliest portion had the lowest tool ratio (Table 2.11). In this portion, tools were primarily Washington Pass chert and Morrison formation material (10 of 17), and the percentage of Washington Pass chert for tools is similar to that found in debitage (Table MF-2.14). In the middle portion of the Trash Mound, the tool ratio was twice as high. While 40 percent of the tools are of Washington Pass chert or Morrison formation material, another one-third are of splintery silicified wood or quartzite (Table MF-2.15).

Although the tool ratio (Table 2.11) was slightly lower in the late portion of the Trash Mound, material frequencies for tools were similar to those in the middle portion (Table MF-2.16); 30 percent of the tools were either Washington Pass chert or Morrison formation material, and another 35 percent of the tools were either splintery silicified wood or quartzite. It would seem that activities represented by Trash Mound deposits changed over time in that activities associated with hammerstone use (indicated by flakes of coarse-grained splintery silicified wood and quartzite, which primarily exhibited battering wear) increased during later periods.

The tool ratios for the portion of Plaza 2 excavated in 1978 were similar to those found in the middle portion of the Trash Mound and in Room 110 (Table 2.11). Almost half of the tools were of exotic material (8 of 17), and none were of coarse-grained material.

As discussed above, there were indications in some Gallup phase proveniences that exotic materials (especially Washington Pass chert) were preferentially selected for tool use. This suggestion was tested with a Chi-square of exotic and local material by tools and debitage for Gallup proveniences excavated in 1978 (Table 2.12). The Chi-square was not significant at the .01 level (X^2 = 6.08, df = 1, Sig > .02 < .01), indicating that exotic materials were not preferentially selected for tool use. The very low frequency of formal tools of Washington Pass chert (the most common exotic material) in Gallup phase deposits provides supporting evidence for the lack of emphasis on exotic material for tool-use activities. Thus, the explanation for the large quantities of exotic materials found in Gallup phase deposits remains unclear.

Formal Tools

Forty-two tools were recovered from Gallup phase proveniences. Twenty-eight were projectile points, seven were perforators, and the remainder were miscellaneous tools. Two-thirds of the identifiable projectile points were side notched, the remaining third corner notched (Table 2.13).

Table 2.13. Gallup phase: formal tools by material type.[a]

	203	204	206	207	209	213	221	223	233	234	235	299	Total	%
Morrison Formation	1	4	1	1	1								8	19.0
Washington Pass	1								1	1			3	7.1
Zuni Sil. Wood							1						1	2.4
Obsidian		1						1					2	4.8
High Surf. Cht		2	2	2	2								8	19.0
Cherty Wood		1		1						2			4	9.5
Splintery Wood							1						1	2.4
Chalcedonic Wd.	1	1								1	1		4	9.5
Other Material	1	2	2	1		1				1	1	2	11	26.2
Totals	4	11	5	5	3	1	2	1	1	5	2	2	42	
%	9.5	26.2	11.9	11.9	7.1	2.4	4.8	2.4	2.4	11.9	4.8	4.8		100.0

[a]203 = corner-notched projectile point
204 = side-notched projectile point
206 = corner-notched projectile point blade fragment
207 = side-notched projectile point blade fragment
209 = miscellaneous blade fragment
213 = small nonhafted knife
221 = knife
223 = saw/denticulate
233 = gouge/chisel
234 = informal perforator
235 = projection on a flake

More than one-fourth of the projectile points are of Morrison formation material; specifically, they are of material types 2205 and 1022. These particular types are very infrequent in debitage (only two flakes of type 1022 and four flakes of type 2205 were found at Pueblo Alto); another variety of Morrison formation material, type 1040, is found most frequently in debitage. This might suggest that these projectile points were not manufactured at the site but arrived in a finished state. Only two other projectile points are of exotic material (one of Washington Pass chert and another of obsidian). Projectile points of local material are primarily high-surface chert (one-fourth of the projectile points) and varieties of silicified wood.

The perforators are almost entirely silicified wood (two cherty silicified wood, two chalcedonic silicified wood and two red silicified wood). One was of Washington Pass chert.

No formal tools were found in primary context. Two-thirds of the formal tools were from the Trash Mound, including all of the perforators.

Cores

Half of the 58 cores from the Gallup phase were of exotic material (Table 2.14): almost one-third were of Washington Pass chert. Other exotic materials were Zuni wood (8.6 percent), Morrison formation material (6.9 percent) and yellow-brown spotted chert (3.4 percent). Local materials were primarily silicified wood (24.2 percent) and quartzite (12.0 percent).

Of the cores analyzed, almost three-fourths were irregular in type. Other types were discoidal (17.3 percent) and polyhedral (9.6 percent). Five of the nine discoidal cores were of Washington Pass chert, and one was of Zuni wood, which suggests specialized treatment of these exotic materials. Of the five polyhedral cores, one was of Zuni wood, the rest of quartzite or sandstone.

Three-fourths of the cores (Tables MF-2.7 through MF-2.19) were from the Trash Mound (n = 45), and most of these were from Test Trench 1 (n = 35). Room 110 produced eight cores, seven from Floor 1.

As discussed earlier, five of the seven cores from Floor 1 of Room 110 were of Washington Pass chert, one of Zuni wood, and one of cherty silicified wood. Most were of irregular type (three of five). Two were discoidal cores, one of Washington Pass chert and one of Zuni wood; two cores were untyped. Reduction of Washington Pass chert and Zuni wood in this room is indicated by the presence of these cores, and the discoidal cores suggest specialized treatment of this material.

Over one-third of the cores from the Trash Mound were of exotic material, primarily Washington Pass chert (24.4 percent). Other exotic materials were Zuni wood (6.7 percent) and yellow-brown spotted chert (4.4

Table 2.14. Gallup phase: core type by material type.

	Irregular	Discoidal	Polyhedral	Untyped	Total	%
Morrison Formation	4				4	6.9
Yellow-Br. Cht.				2	2	3.5
Washington Pass	11	5		2	18	31.0
Zuni Sil. Wood	3	1	1		5	8.6
High Surf. Cht.	1				1	1.7
Cherty Sil. Wood	6			1	7	12.1
Splintery Sil. Wd.	1				1	1.7
Chalcedonic Wood	4	1		1	6	10.3
Quartzite	3	2	2		7	12.1
Other Material	5		2		7	12.1
Totals	38	9	5	6	58	
%	65.5	15.5	8.6	10.3		100.0

Table 2.15. Late Mix Phase: material type by site area.

	West		North		East		Total	
	n	%	n	%	n	%	n	%
Morrison Formation	35	3.3	45	2.6	1	0.3	81	2.5
Yellow-Brown Chert	21	2.0	57	3.2	1	0.3	79	2.5
Washington Pass	158	14.8	382	21.7	29	7.8	569	17.8
Zuni Sil. Wood	25	2.3	13	0.7	3	0.8	41	1.3
Obsidian	34	3.2	177	10.1	32	8.6	243	7.6
High Surf Chert	91	8.5	195	11.1	19	5.1	305	9.5
Cherty Sil. Wood	265	24.8	127	7.2	59	15.9	451	14.1
Splintery Sil. Wood	27	2.5	125	7.1	141	37.9	293	9.2
Chalcedonic Wood	192	18.0	227	12.9	37	9.9	456	14.3
Quartzite	48	4.5	83	4.7	14	3.8	145	4.5
Other Material	171	16.0	327	18.6	36	9.7	534	16.7
Total	1,067	100.0	1,758	100.0	372	100.0	3,197	100.0

Proveniences Groups Included:

West: 3,28,72,84,17,85,4,29,16,18,68,7,87,103,89
North: 33,36,40,55,59,64,66,80,
East: 82,83,142,102,107,108

percent). The two cores of yellow-brown spotted chert were the only cores of this material from the Gallup phase. Local materials were primarily silicified wood (28.8 percent) and quartzite (15.6 percent). Most of the cores were irregular (31 of the 42 typed); seven were discoidal and four polyhedral. Four of the eleven Washington Pass chert cores were discoidal, and four of the seven quartzite cores were either discoidal or polyhedral.

Discoidal and polyhedral cores indicate use of a patterned reduction strategy, and material frequencies for cores suggest that Washington Pass chert may have been more frequently reduced in a patterned manner than other material types. However a Chi-square test of core type (irregular versus discoidal and polyhedral) by material type (exotic versus local) was not significant at the .01 level ($x^2 = .02$, df = 1, Sig > .90 < .95), indicating no difference in use of a patterned reduction strategy for exotic or local material.

Late Mix Phase

Provenience Groups

The Late Mix phase represented the last major ocupation of the site, and proveniences assigned to this phase occurred in most areas of the site as "household trash." In some areas trash deposits appeared to be the result of special, nondomestic activities (Windes, Volume II of this report). Trash deposits were found in roof fall, wall fall, wall clearing, plaza surfaces, and kiva fill. The Trash Mound contained very little cultural material dating to the Late Mix phase, and it appeared that during this period most trash was deposited in abandoned kivas.

Proveniences containing chipped stone that had been assigned to the Late Mix phase were combined into spatial units as described above in Use of Proveniences (Table 2.4). These spatial units can be grouped by site area: west, north, and east areas of the site (Table 2.15). Other proveniences assigned to the Late Mix phase included Plaza 2, Plaza Feature 1, and Other Structures 4 and 6.

Almost 40 percent of the chipped stone from the Late Mix phase is from two proveniences: tests in Kiva 16 in the West Plaza (n = 500) and Kiva 10 in the North Plaza (n = 1246).

Material Type Variability

As in the Gallup phase, Washington Pass chert is still the most common exotic material found in Late Mix proveniences (Tables MF-2.20 through MF-2.32), but percentages are somewhat lower than in the Gallup phase. Obsidian is more common than in assemblages of earlier periods, and yellow-brown spotted chert also occurs somewhat more frequently than

in earlier periods. Frequencies of local materials vary between different areas of the site, however. Cherty silicified wood, splintery silicified wood, and miscellaneous material are the most common types.

Material type frequencies are more similar among proveniences within each of the western, northern, and eastern portions of the site and differ among these site areas (Tables MF-2.20 through MF-2.32). The association of these proveniences (roomblock, adjacent plazas, and plaza kivas) within each of the three areas of the site during the Late Mix phase was tested with a principal components analysis (Figure 2.1). The results indicate that, in terms of material frequencies, proveniences tend to be similar within these three site areas.

The difference noted among the three areas of the site may be the result of different patterns of use associated with major site areas during this period. Windes (Volume I of this report) notes that, during the Late Mix phase, activities seem to have been concentrated on rooftops, and trash deposition was in associated plaza and kiva areas rather than in the formal Trash Mound or on room floors (as in the Gallup phase). This would explain the similarity in materials found in roomblocks and adjacent plaza and plaza kiva areas.

Proveniences in the north portion of the site (Table 2.15) have the highest percentage of exotics, especially Washington Pass chert and obsidian, whereas local materials are primarily other materials and chalcedonic silicified wood. Proveniences in the western portion of the site (Table 2.15) have fewer exotic materials than those in the north portion, but Washington Pass chert remains the most common exotic. Local materials are primarily cherty silicified wood and chalcedonic silicified wood. The eastern portion of the site differs most from the other two areas (Table 2.15). It has a very low frequency of exotics, with similar frequencies of Washington Pass chert and obsidian. Local materials are dominated by splintery silicified wood.

Interestingly, other Late Mix proveniences had material frequencies that were most similar to the site area nearest them. Plaza 2, located east of the East Roomblock, had material frequencies similar to those of the eastern portion of the site (Table MF-2.29). Plaza Feature 1 (Table MF-2.30) is located in the western area of the plaza, and percentages of exotic materials were similar to those in the western portion of the site. However, unlike the western portion of the site, local materials were dominated by other material. Other Structures 4 and 6 (Table MF-2.31) are located in the southeastern corner of the site in an arc that encloses the plaza, and material frequencies there are similar to those of the eastern portion of the site. The association of these three proveniences with specific site areas lends support for the suggestion of area-specific site activities during the Late Mix phase.

<u>The East Area of Plaza 1</u>. Two grids located in the East Plaza are unusual. Plaza Grid 115, which was included with the East Plaza (Table MF-2.28), produced 38 pieces of chipped stone, 28 of obsidian. The obsid-

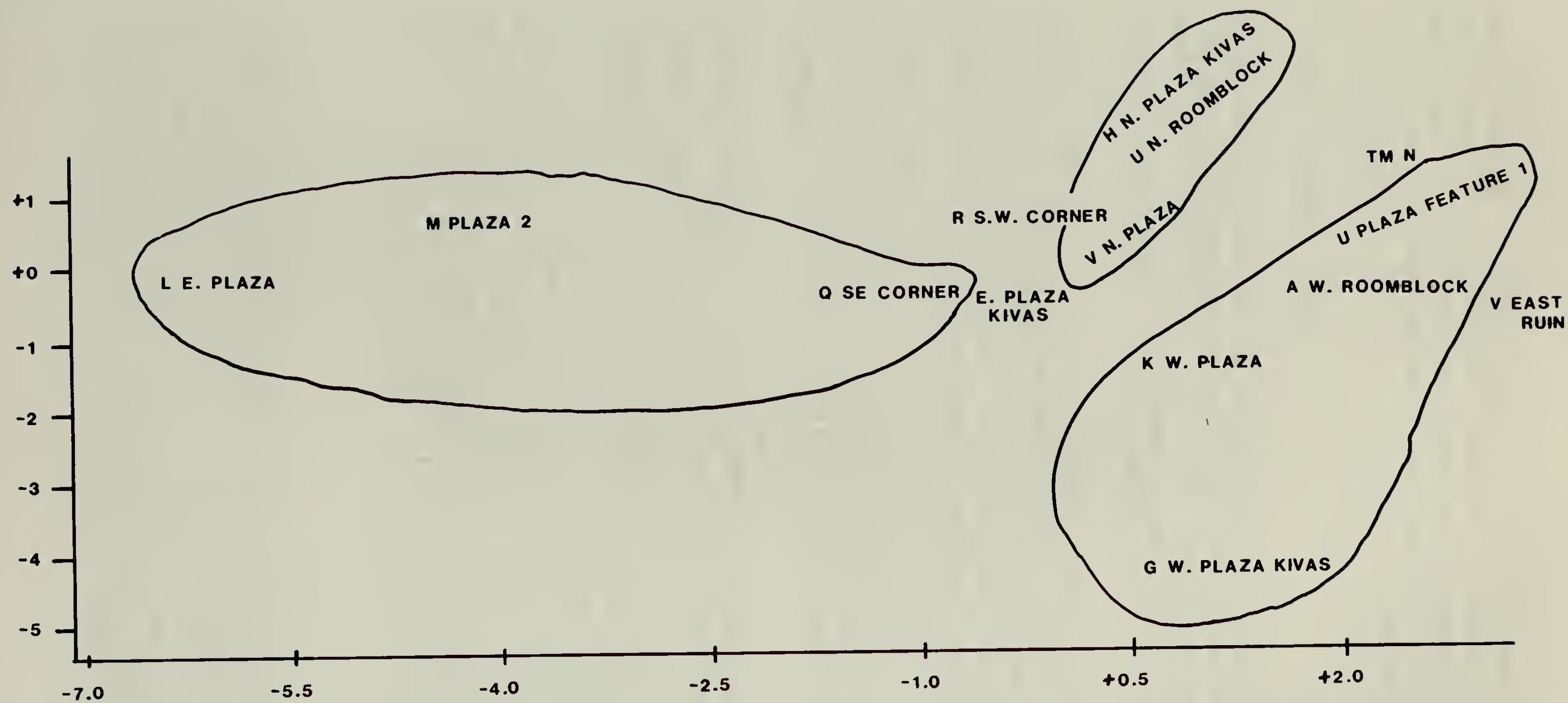

Figure 2.1. Principal Components Analysis (Plot of Factor 1 * Factor 2).

Materials were grouped as follows:

Morrison Formation materials	Cherty silicified wood
Washington Pass chert	Splintery silicified wood
Obsidian	Chalcedonic silicified wood
Other Exotics	Other Materials

The first three factors account for 80% of the variance. Factor 1 shows a high positive loading on Other Materials and a high negative loading on Splintery silicified wood. Factor 2 shows a high positive loading on Obsidian and a high negative loading on Cherty silicified wood.

ian was primarily unutilized pieces of angular debris. Adjacent Plaza Grid 95 produced six more pieces of obsidian. All but two pieces of obsidian were from the Jemez source. Although this may not have been primary context material (Powers, personal communication, 1980) it seems to be the result of one flaking episode.

Artifact Type Variability

Most of the spatial groups of proveniences in the Late Mix period had components that were excavated in both 1977 (not microscopically examined) and in 1976 and 1978 (microscopically examined). Proveniences excavated in 1977 have low tool ratios, whereas proveniences excavated in 1976 and 1978 have much higher tool ratios (Table 2.16).

Of the 1977 proveniences, West Roomblock room fill, West Plaza, East Plaza kivas, and Plaza Feature 1 have comparatively high tool ratios. Plaza Feature 1 has an especially high ratio; however, the number of lithics from this provenience is very low. Almost one-third of the utilized and retouched flakes from West Roomblock room fill proveniences are of one material type, a light-colored cherty silicified wood (1113), which is generally a very high quality material. In the West Plaza, one-third of the utilized and retouched flakes are of exotic materials, although exotic material is much less frequent in debitage. High tool ratios in these proveniences may indicate tool use activities represented by these deposits.

Of the proveniences excavated in 1976 and 1978, only Other Structure 4 has a comparatively low tool ratio (Table 2.16); however, the total frequency in ths provenience is very low (n = 25). The West Plaza has the highest tool ratio, but, again, the total is low (n = 34). North Roomblock roof fall also has a high tool ratio, including six projectile points (seven other projectile points were found in North Roomblock roof fall in 1977, despite the fact that tool ratios were low.) Although most of the projectile points are of other material, over half of the utilized and retouched flakes are of exotic material, primarily Washington Pass chert and obsidian. The tool ratio for roof fall material (both in the North Roomblock and West Roomblock) supports the suggestion that tool use activities during the Late Mix phase occurred on roof surfaces.

Formal Tools

Sixty-seven formal tools were recovered from Late Mix phase proveniences. Fifty-eight were projectile points, five were drills or perforators, three were large nonhafted blades, and one was an unknown tool (Table 2.17). Two-thirds of the identifiable projectile points were side notched, and most of the rest were corner notched. These type frequencies are almost identical to those of the Gallup phase, which indicates little change in projectile point morphology between these two periods.

Table 2.16. Late Mix phase: ratio of tools to all chipped stone.

Provenience	1977	1978
West Wing Wall Fall		0.30
West Wing Roof Fall	0.13	0.43
West Wing Room Fill	0.24	0.34
West Plaza Kivas	0.12	
West Plaza	0.25	0.47
North Wing Roof Fall	0.12	0.46
North Plaza Kivas		0.38
East Plaza Kivas	0.20	
East Plaza	0.16	
Plaza 2	0.11	
Plaza Feature 1	0.34	0.36
Other Structure 4		0.24
Other Structure 6	0.17	

Table 2.17. Late Mix phase: formal tools by material type.[a]

	203	204	206	207	209	210	214	215	218	231	234	235	299	Total	%
Morrison Formation	1	4	1	2										8	11.9
Yellow-Brown Chert	1													1	1.5
Washington Pass		1				1								2	3.0
Obsidian		1			2									3	4.5
High Surf. Chert	3	6	3	1		1			1			1	1	17	25.4
Cherty Wood		2	1				1	1		3				8	11.9
Chalcedonic Wood		4									1			5	7.4
Other Material	2	10	3	2	5	1								23	34.0
Total	7	28	8	5	7	3	1	1	1	3	1	1	1	67	
	10.4	41.8	11.9	7.5	10.4	4.5	1.5	1.5	1.5	4.5	1.5	1.5	1.5		100.0

[a]203 = corner-notched projectile point
204 = side-notched projectile point
206 = corner-notched projectile point blade fragment
207 = side-notched projectile point blade fragment
209 = miscellaneous blade fragment
210 = large nonhafted blade
214 = asymmetrical/irregular projectile point
215 = large corner-notched projectile point
218 = renotched side-notched projectile point
231 = formal drill
234 = informal perforator
235 = projection on a flake
299 = other/unknown tool

Exotic material was less frequent in formal tools (20 percent) than in the debitage (29 percent) during the Late Mix phase. Only projectile points were made of exotic material, and these were found almost exclusively in two proveniences (Kiva 10 and Plaza 2). Morrison formation material was the most common exotic material in tools, followed by obsidian. The particular Morrison formation materials used (types 2205 and 1022) are rarely found in the debitage, which suggests that these projectile points were not manufactured at the site. (These material types were also common to projectile points of the Gallup phase.)

Unlike those in the Gallup phase, three of the five tools classed as drills or perforators were formal drills (drills from the Gallup phase were all informal), and all three were all of cherty silicified wood.

Over half of the formal tools were found in the northern portion of the site (Tables MF-2.23, MF-2.25), in roof fall and in Kiva 10. Unlike those in Kiva 10 and Plaza 2, formal tools in North Roomblock roof fall were all projectile points of local material, primarily silicified wood. The large number of formal tools from Kiva 10 included six, side-notched, projectile points, all of Morrison formation material and of very similar appearance. The concentration of formal tools in these two proveniences supports the suggestion that trash from rooftop activities was deposited in adjacent kivas.

The west portion of the site (Tables MF-2.20, MF-2.21, MF-2.22, MF-2.24, and MF-2.27) produced 10 formal tools, 6 from the roomblock and 4 from Kiva 16, all of local material. Plaza 2 (Table MF-2.29) produced seven projectile points, four of which were of exotic material of four different types. Smaller numbers of formal tools were found in other proveniences.

Cores

More than one-fourth of the 38 cores from the Late Mix phase were of exotic material (Table 2.18), a proportion similar to that of the debitage. Washington Pass chert was the most common exotic type (n = 6), followed by Morrison formation (type 1040, n = 2). One core each of yellow-brown spotted chert, Zuni Wood, and Jemez obsidian was also recovered. Local materials were primarily cherty silicified wood (29 percent), high surface chert (16 percent), and other material (16 percent).

Almost 85 percent of the cores were of the irregular type (n = 32), including most cores of exotic material. The frequency of irregular cores is higher during the Late Mix phase than during either of the two earlier phases, a possible indication of decreased emphasis on patterned techniques of reduction during this period.

The largest number of cores (n = 13) were from miscellaneous proveniences (primarily Other Structures and Major Walls). This includes half of the Washington Pass chert cores and a core of Morrison formation mater-

Table 2.18. Late Mix phase: core type by material type.

	Irregular	Discoidal	Polyhedral	Wedge	Untyped	Total	%
Morrison Formation	2					2	5.3
Yellow-Brown Chert	1					1	2.6
Washington Pass	6					6	15.8
Zuni Sil. Wood	1					1	2.6
Obsidian			1			1	2.6
High Surface Chert	6					6	15.8
Cherty Sil. Wood	9	1		1		11	28.9
Splintery Sil. Wood					1	1	2.6
Chalcedonic Wood	1	1				2	5.3
Quartzite	1					1	2.6
Other Material	4	2				6	15.8
Totals	31	4	1	1	1	38	
%	81.5	10.5	2.6	2.6	2.6		100.0

ial (Table MF-2.32). Roof fall in the West Roomblock produced four cores, whereas roof fall in the North Roomblock produced a single discoidal core. These frequencies contrast with those of formal tools that were more common in the North Roomblock. There is no obvious similarity between cores in roof fall and those in adjacent plaza kivas.

A polyhedral core of Jemez obsidian (one of only two obsidian cores found at the site) was from Other Structure 6, which is close to the east portion of the site, the area of highest obsidian concentration.

Obsidian

Source Locations

Three hundred forty-eight pieces of obsidian were recovered from Pueblo Alto, less than 3 percent of the chipped stone total. Three hundred twenty-eight pieces were from 11 distinct sources (Table 2.19), based on x-ray fluorescence analysis (Cameron and Sappington 1984). The remaining 20 pieces could be assigned to sources on the basis of visual characteristics.

Almost 85 percent of the obsidian from Pueblo Alto was from the Jemez Mountains source (Table 2.19), located about 90 km east of Chaco Canyon. An additional 5 percent is from the Polvedera Peak source, just north of the Jemez source. Sources in the San Francisco Peaks area of north-central Arizona (over 300 km west of Chaco Canyon) make up another 5 percent of the total. The remaining 26 pieces represent various sources in New Mexico, Arizona, Utah, and Colorado, which range in distance from 200 to almost 600 km from Chaco Canyon (Cameron and Sappington 1984).

Artifact Types

Only 10 formal tools of obsidian were recovered, 9 of which were projectile points (Table 2.19). Four were of Jemez obsidian; four others were of Red Hill obsidian, a relatively uncommon source at Pueblo Alto. Two cores were of Jemez obsidian, confirming onsite reduction of this material type.

Half of the obsidian debitage was recorded as utilized or retouched flakes. The tool ratio for obsidian (0.53) was much higher than that of the lithic assemblage as a whole. This high frequency may reflect the brittle character of obsidian, which would be much more likely to exhibit edge damage, whether of an intentional or unintentional nature.

Table 2.19. Obsidian from Pueblo Alto by artifact type.

Obsidian Source	Points		Misc. Tools		Util/Ret Flakes		Debitage		Cores		Total	
	n	%	n	%	n	&	n	%	n	%	n	%
Grants, NM					1	50.00	1	50.00			2	0.57
Jemez, NM	3	1.04	1	0.34	158	54.86	124	43.06	2	0.69	288	82.76
Polvedera, NM					4	23.53	13	76.47			17	4.89
Mule Creek, NM	1	16.67			2	33.33	3	50.00			6	1.72
Red Hill, NM	4	40.00					6	60.00			10	2.87
San Antonio, NM	1	50.00					1	50.00			2	0.57
San Francisco Pks, AZ					8	47.06	9	52.94			17	4.89
Superior, AZ					1	100.00					1	0.29
Utah Sources					1	50.00	1	50.00			2	0.57
Cochetopa, CO							1	100.00			1	0.29
Unknown					1	50.00	1	50.00			2	0.57
Totals	9		1		176		160		2		328	
%		2.59		0.29		50.57		45.98		0.57		100.00

Temporal Variation

Patterns within Chaco Canyon

The sources from which obsidian was obtained changed over time at sites in Chaco Canyon. The form in which it was obtained also changed through time for some sources, from acquisition of formal tools to acquisition of raw material (Cameron and Sappington 1984). This section will briefly summarize Canyon-wide trends. Patterns at Pueblo Alto will be discussed in the next section.

Red Hill obsidian occurs most often at sites in Chaco Canyon that predate A.D. 700 (Cameron and Sappington 1984). From A.D. 920-1020 (which includes the Red Mesa phase at Pueblo Alto) use of this source declined in the Canyon, but Red Hill obsidian still represents more than one-fourth of the obsidian found at Chaco Canyon sites. Before about A.D. 920 Red Hill obsidian was more likely to occur as flakes at sites in Chaco Canyon (Cameron and Sappington 1984:166) whereas after A.D. 920 Red Hill obsidian is found as formal tools.

During the period from A.D. 1020-1120 (which includes the Gallup phase at Pueblo Alto), Jemez obsidian comprised 65 percent of the obsidian found at sites in Chaco Canyon and Polvedera Peak obsidian another 10 percent (Cameron and Sappington 1984). After A.D. 920 Jemez obsidian occurred mainly as flakes, rather than formal tools.

From A.D. 1120-1220 (which includes the Late Mix phase at Pueblo Alto), Jemez obsidian comprised almost 90 percent of the obsidian found at sites in Chaco Canyon and Polvedera Peak obsidian another 5 percent. Most of the Jemez obsidian during this period is debitage. It should be noted that most of the material used for making calculations for the period from A.D. 1120-1220 is, in fact, from Pueblo Alto.

Patterns at Pueblo Alto

In general, temporal variation in obsidian sources and form at Pueblo Alto follows patterns observed for all Chaco Canyon sites.

Only 10 pieces of obsidian (3 percent of the total obsidian) were found in Red Mesa phase proveniences (Table 2.20). Half of these were from the Red Hill source; four of these five were projectile points (the four formal tools of Red Hill obsidian discussed above). The predominance of formal tools from the Red Hill source conforms with patterns noted at other sites in Chaco Canyon during this period.

More than two-thirds of the obsidian from the Gallup phase was from the Jemez source (Table 2.21) and another 16 percent from the nearby Polvedera source, proportions very similar to those found at other sites in Chaco Canyon. Only two formal tools, both of Jemez obsidian, were associated with this period; as at other sites, most Jemez obsidian occurred as flakes.

Table 2.20. Red Mesa phase: obsidian by artifact type.

Obsidian Source	Points	Misc. Tools	Util/Ret Flakes	Debitage	Total	%
Grants			1	1	2	20.0
Jemez	1		1		2	20.0
Red Hill	3	1		1	5	50.0
Superior			1		1	10.0
Totals	4	1	3	2	10	
%	40.0	10.0	30.0	20.0		100.0

Table 2.21. Gallup phase: obsidian by artifact type.

Obsidian Source	Points	Misc. Tools	Util/Ret Flakes	Debitage	Total	%
Jemez	1	1	6	9	17	68.0
Polvedera				4	4	16.0
San Francisco Peaks			1	2	3	12.0
Utah Sources			1		1	4.0
Totals	1	1	8	15	25	
%	4.0	4.0	32.0	60.0		100.0

Table 2.22. Late Mix phase: obsidian by artifact type.

Obsidian Source	Points	Misc. Tools	Util/Ret Flakes	Debitage	Cores	Total	%
Jemez	1		140	101	1	243	84.9
Polvedera			4	9		13	4.5
Mule Creek		1	2	3		6	2.1
Red Hill			1	4		5	1.7
San Antonio		1		1		2	0.7
San Francisco Peaks			7	6		13	4.5
Utah Sources				1		1	0.4
Cochetopa				1		1	0.4
Unknown			1	1		2	0.7
Totals	1	2	154	128	1	286	
%	0.4	0.7	53.8	44.7	0.4		100.0

Over 80 percent of the obsidian from Pueblo Alto is from the Late Mix phase (Table 2.22). (As noted above, most of the obsidian during the period from A.D. 1120-1220 came from Pueblo Alto.) Eighty-five percent of the obsidian from the Late Mix phase at Pueblo Alto is from the Jemez source, and only three formal tools (projectile points) were associated with this phase. Only one of the projectile points was of Jemez obsidian, whereas the other two were of uncommon sources (Mule Creek and San Antonio Peak, New Mexico).

Obsidian Summary

The use of Jemez obsidian seems to have increased during the Late Mix phase. This conclusion is supported by the high percentage of obsidian reported at Kin Kletso (Vivian and Mathews 1965), another Chaco Canyon site that has also been dated to the early A.D. 1100s (Lekson 1984). As discussed below, however, the quantities of obsidian imported into Chaco Canyon during this period do not seem to indicate large-scale trade (Cameron and Sappington 1984).

The form in which obsidian arrived at Pueblo Alto also changed over time from the import of finished tools of Red Hill obsidian to the import of Jemez area material.

Chipped Stone Summary

Temporal Variability in Exotic Material Selection

During the Red Mesa phase at Pueblo Alto, exotic materials constituted only about 10 percent of the assemblage (Table 2.23). Exotic materials increased to over 35 percent of the assemblage during the Gallup phase and then dropped to less than 30 percent of the assemblage during the Late Mix phase. This pattern suggests a temporal shift in access to nonlocal sources.

Although percentages varied, the most common exotic material during all time periods at Pueblo Alto was Washington Pass chert. Other exotic materials show varying proportions through time (Table 2.23). During the Red Mesa phase, other exotics were infrequent; Morrison formation material and Zuni Wood became more frequent during the Gallup phase, and during the Late Mix phase, obsidian made up almost 7 percent of the assemblage. The Late Mix phase also had the highest percentage of yellow-brown spotted chert and a relatively high frequency of Morrison formation material.

Populations at Pueblo Alto seem to have had the greatest contact with the Chuska Mountains where the source for Washington Pass chert is located, and this association seems to have been strongest during the Gallup

Table 2.23. Temporal variation in material type.

	Red Mesa Phase		Gallup Phase		Late Mix Phase	
	n	%	n	%	n	%
Morrison Formation	20	1.3	294	5.11	102	2.45
Yellow-Brown Chert			36	0.63	96	2.31
Washington Pass	142	9.1	1,502	26.10	669	16.09
Zuni Sil. Wood	11	0.7	210	3.65	54	1.30
Obsidian	10	0.6	25	0.43	286	6.88
High Surf Chert	133	8.5	248	4.31	380	9.14
Cherty Sil. Wood	330	21.1	561	9.73	572	13.76
Splintery Sil. Wood	61	3.9	1,236	21.48	552	13.28
Chalcedonic Wood	455	29.1	492	8.53	547	13.16
Quartzite	97	6.2	471	8.18	184	4.43
Other Material	304	19.4	682	11.85	716	17.22
Total	1,563		5,757		4,158	
%		100.0		100.0		100.0

phase. The increased frequency of obsidian during the Late Mix phase suggests contact to the east, the source of Jemez obsidian.

Although exotic materials were common during the Gallup and Late Mix phases, the quantity of these materials imported to Pueblo Alto does not indicate large-scale trade. Based on flake weights for excavated material and percentage of the site dug, a total of only 130 kg of Washington Pass chert may have been imported to Pueblo Alto during the Gallup phase. This quantity of material could have been transported from the source in the Chuska Mountains in only a few trips (Cameron 1984). Likewise, a total of only 3.6 kg of Jemez obsidian may have been imported to Pueblo Alto during the Late Mix phase, a quantity that could have been procured in one trip to the Jemez source (Cameron and Sappington 1984). Quantities of other exotic materials are equally small or smaller.

Although procurement mechanisms for exotic materials at Pueblo Alto are not clear, Washington Pass chert may have been acquired incidentally during acquisition of other goods in the Chuska Mountains (pottery or architectural beams), and obsidian at Pueblo Alto may represent only occasional acquisition or informal exchange (Cameron 1984; Cameron and Sappington 1984).

Functional Associations of Local Material

Certain types of local materials were probably selected for the performance of specific tasks. Splintery silicified wood was probably associated with hammerstone use (Cameron 1982), possibly related to site-construction activities and/or ground-stone manufacture or maintenance. Evidence that most of the construction at Pueblo Alto took place just before the Gallup phase (Windes, Volume I of this report) parallels a high percentage of splintery silicified wood in Gallup phase proveniences.

The many flakes of splintery silicified wood and other coarse-grained materials in Room 110 are probably related to hammerstones found with mealing bins and other evidence of corn-processing activities in this room.

Chalcedonic silicified wood has been associated with turquoise production and bead working in other sites at Chaco Canyon (Cameron 1980; Mathien 1981). This material was frequently used for small drills especially during the late A.D. 900s and early 1000s. Although no drills or perforators were recovered from Red Mesa contexts, chalcedonic silicified wood was most common at Pueblo Alto during the Red Mesa phase, and there is an association of beads and turquoise with this material.

Formal Tools

Only 132 formal tools were recovered from Pueblo Alto, less than 2 percent of the chipped stone assemblage (a proportion similar to that at

other Chaco Canyon sites). Almost 80 percent of these formal tools are projectile points.

Projectile point forms change through time from corner-notched types during the Red Mesa phase (Table 2.7) to side-notched varieties in the later two periods.

Some projectile points were made of materials not commonly found as debitage. This suggests that these projectile points may not have been manufactured at Pueblo Alto, but may have been brought to the site in a finished state. Almost one-third of the projectile points were made of exotic material (Table 2.24), and another one-third were of local material types, generally infrequent in the chipped stone population (Other Material). It is noteworthy that Washington Pass chert, the exotic material most common in debitage (20 percent of the total assemblage), is relatively infrequent in tools (6 percent of formal tools).

Some exotic materials seemed to have been specifically selected for projectile point manufacture. Seventeen projectile points (16 percent of the projectile points) were of Morrison formation material, but they were of types 1022 and 2205, whereas Morrison formation debitage was almost exclusively of type 1040. These Morrison formation projectile points were formally quite similar (Lekson 1979) and were found in Gallup and Late Mix phases, but not in the Red Mesa phase.

One-fourth of the projectile points were of high-surface chert, a local material type that was less than 10 percent of the debitage. However, the difficulty in seeing woody structure on a projectile point may mean that many projectile points of chalcedonic silicified wood were classified as high surface chert, as both tend to be clear and chalcedonic.

Formal drills are found only in the Late Mix phase (three of the five drill/perforators), whereas the Gallup phase produced only informal perforators. Drills were almost all local material, primarily cherty silicified wood.

To summarize, the types of materials selected for formal tools changed over time: half of the Red Mesa phase formal tools were of exotic material, primarily obsidian (Table 2.7); only 30 percent of the Gallup phase tools were of exotic material (more than half of these were Morrison formation) (Table 2.13); only 20 percent of the Late Mix phase tools were of exotic material (again mostly Morrison formation) (Table 2.17). Sample size should be considered in the apparent decrease in use of exotic material for formal tools.

Cores

Of the 124 cores recovered from Pueblo Alto, one-third were of exotic material (Table 2.25), primarily Washington Pass chert. The most common local materials were cherty silicified wood and other material. Material

Table 2.24. Formal tools from Pueblo Alto by material types.

	Projectile Points	Drills	Miscellaneous Tools	Total	%
Morrison Formation	17			17	12.8
Yellow-Brown Chert	1			1	0.8
Washington Pass	5	1	2	8	6.1
Zuni Sil. Wood			1	1	0.8
Obsidian	9		1	10	7.6
High Surf. Chert	26	1	3	30	22.7
Cherty Sil. Wood	8	6		14	10.6
Splintery Sil. Wood			1	1	0.8
Chalcedonic Wood	5	3	1	9	6.8
Quartzite			1	1	0.8
Other Material	33	3	4	40	30.3
Totals	104	14	14	132	
%	78.8	10.6	10.6		100.0

Table 2.25. Cores from Pueblo Alto by material type.

	Irreg.	Disc.	Poly.	Wedge	Untyped	Total		Debitage	
						n	%	n	%
Morrison Formation	6	1				7	5.6	437	3.54
Yellow-Brown Chert	1				2	3	2.4	142	1.15
Washington Pass	18	7			2	27	21.8	2,472	20.05
Zuni Sil. Wood	5	1	1			7	5.6	291	2.36
Obsidian	1		1			2	1.6	348	2.82
High Surf Chert	10					10	8.1	830	6.73
Cherty Sil. Wood	22	2		3	1	28	22.6	1,594	12.93
Splintery Sil. Wood	1				1	2	1.6	1,966	15.95
Chalcedonic Wood	7	2		1	2	12	9.7	1,626	13.19
Quartzite	5	2	2			9	7.3	789	6.40
Other Material	10	3	2		2	17	13.7	1,833	14.87
Totals	86	18	6	4	10	124		12,328	
%	70.2	14.5	4.8	3.2	7.3		100.0		100.00

frequencies for cores were generally similar to those for debitage (Table 2.25). However, the frequency of cherty silicified wood was much higher for cores than for debitage, and frequency of splintery wood is much lower. Splintery silicified wood is commonly used for hammerstones, and flakes of this material may be the result of hammerstone manufacture or use. The hammerstones that presumably produced the flakes of splintery silicified wood were not included in the core analysis, which caused the discrepancy in core and debitage frequencies for this material type.

Of the cores analyzed (n = 114), three-fourths were of irregular type, an indication of an expedient technology. Wedge cores, which were all of silicified wood, were primarily the result of the blocky form in which this material occurs. The two remaining core types (discoidal and polyhedral) represent patterned reduction strategies. Patterned core reduction is exhibited by little more than 20 percent of the cores. Although almost half of the patterned cores were of exotic material, a Chi-square test of core type by material type (Table 2.26) showed no significant variability. The Gallup phase had the highest frequency of patterned cores.

Comparisons with Chipped Stone from Small Sites in Chaco Canyon

Pueblo Alto is the only town site extensively excavated by the Chaco Center. At this site the period that produced the greatest amount of material was the Gallup phase. Chipped stone use at Pueblo Alto during the Gallup phase seems to have been quite different than that found at small sites in Chaco Canyon. It should be noted, however, that perhaps none of the small sites excavated by the Chaco Center have deposits that are exactly contemporaneous with those from the Gallup phase at Pueblo Alto (Cameron 1984). The small site most frequently used in comparisons with this period, 29SJ 627, has deposits that are slightly earlier than those from the Gallup phase at Pueblo Alto.

Consumption Levels

The rate at which chipped stone was used was compared for the Gallup phase at Pueblo Alto and small sites of other time periods in Chaco Canyon (Cameron 1984). Calculations were made of the duration of occupation, the number of households (defined architecturally), and the percentage of the site excavated for Pueblo Alto (using only data from the Gallup phase) and several small sites in Chaco Canyon (which are both earlier and later than the Gallup phase at Pueblo Alto). These figures were applied to the total amount of chipped stone recovered at each site, and a figure for the volume of chipped stone consumed per household per year was computed (Cameron 1984) (Table 2.27).

The rate at Pueblo Alto during the Gallup phase (over 900 pieces/household/year) was much higher than at smaller sites (less than 400 pieces/household/year). Similar calculations for ceramics showed a

Table 2.26. Comparison of patterned and unpatterned cores by material type.

	Patterned	Unpatterned	Total
Exotic	31 (33.2)	11 (8.8)	42
Local	59 (56.8)	13 (15.2)	72
Totals	90	24	114

$X^2 = 1.1$
df = 1
Prob. >.3<.2

( ) = expected value

Table 2.27. Volume of chipped stone used at Pueblo Alto compared to other Chaco Canyon sites.

Site	No. Households	Years Occupied	Volume of Chipped Stone/ Household/year (grams)
29SJ 389 (A.D.1050-1100)	20	50	922.0
29SJ 627	3	225	161.3
29SJ 629	2	130	166.2
29SJ 633	3	30	222.8
29SJ 724	2	20	375.3

consumption rate more than five times as great at Pueblo Alto than at smaller sites (Cameron 1984; Toll 1984). Rather than indicating actual consumption, these figures probably indicate a far larger population at Pueblo Alto during the Gallup phase than would be indicated by architecture alone. As the number of households was estimated from architectural data, the population may not have been in permanent residence.

Flake/Tool Ratios

A comparison of the ratio of flakes to formal tools has shown similar values for Pueblo Alto (103.9) and smaller sites (90.0) (Cameron 1984). These calculations were based on material from all time periods at Pueblo Alto, whereas the smaller sites (29SJ 627 and 29SJ 629) are earlier than most of the material from Pueblo Alto. (It should be noted that this ratio is different from that described in the Analysis, Analytic Methods, above, and used in discussing artifact type variability, as it uses only formal tools in calculating a flake/tool ratio.) A re-examination of the flake-to-tool ratio at Pueblo Alto does show variation over time:

Time Period	Ratio: Flake/Tools
Red Mesa phase	104.4
Gallup phase	137.0
Late Mix phase	62.1

The Gallup phase at Pueblo Alto has a more than 50 percent higher ratio than smaller sites, whereas the Late Mix phase has a 30 percent lower ratio. This suggests more raw material reduction during the Gallup phase at Pueblo Alto, which might also be reflected in the higher chipped-stone consumption rates noted for this period above. The lower figure for the Late Mix phase may be related to the abandonment of the site: formal tools left at the site were not scavenged and reused by later occupants, thus increasing the number of tools recovered archeologically. Interestingly, the ratio for the Red Mesa phase, which equates temporally with much of the material from the two smaller sites, is very similar to that found at small sites.

Tool Forms

The types of tools found at Pueblo Alto and smaller sites seem to differ. At smaller sites, fewer than half of the formal tools are projectile points (Cameron 1982), while at Pueblo alto, projectile points comprise from almost 70% to over 90% of the formal tool assemblage. This suggests an emphasis on hunting (or possibly warfare) at Pueblo Alto. Akins (this volume) has found large quantities of faunal remains at Pueblo Alto during the Gallup phase, which would tend to support the association of projectile points with hunting.

Conclusions

Chipped stone assemblages at Pueblo Alto, especially during the Gallup phase were remarkably different from chipped stone assemblages at smaller sites in Chaco Canyon. To summarize, exotic materials, especially Washington Pass chert, were much more frequent at Pueblo Alto than at smaller sites (Cameron 1982): chipped stone was consumed at a far greater rate than would be expected from architectural estimates of population; flake-to-tool ratios were greater at Pueblo Alto during the Gallup phase; projectile points were proportionately more frequent at Pueblo Alto than at smaller sites.

As with other types of data (ceramic, faunal), chipped stone at Pueblo Alto reflects intense use of the site, primarily during the Gallup phase. As discussed elsewhere (Cameron 1984), periodic aggregration of a large population at Pueblo Alto (suggested by Windes, Volume I of this report, Toll and McKenna, this volume, and others, this volume) may be indicated by chipped stone data.

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Chapter Three

Chipped Stone Tools from Pueblo Alto

Stephen H. Lekson

Pueblo Alto produced 115 chipped stone tools. Over three-quarters of these were arrow points or arrow-point fragments. Only eight other pieces were large bifaces or other formal, bifacially worked tools, and several of these are probably reused archaic points. The remainder of the chipped stone tools were crude drills or perforators, none of which were facially flaked. This tool assemblage is consistent with other contemporary chipped-stone tool assemblages at Chaco Canyon.

Arrow Points

The major tool category is arrow points--projectile points with minimum stem widths of 10 mm or less. As a group, the Pueblo Alto arrow points are very much like the contemporary points at other Chaco Canyon sites and other sites in the Anasazi area.

Thirteen arrow points were corner-notched (Plates 3.1 and 3.2). Earlier deposits at Pueblo Alto produced a form we have called corner-notched, although it actually represents a formal transition between corner and side notching (Plate 3.1:7,8; Plate 3.2:8,9). These points have strongly excurvate bases and are notched directly above the juncture of base and blade, with deep narrow notches acute to the long axis of point. Points similar or identical to these are found in contexts dating to from about A.D. 900 to A.D. 1040 elsewhere in Chaco Canyon, and this seems to be the case at Pueblo Alto as well.

The form of corner-notched points at Pueblo Alto differed in no significant way from corner-notched points from other Chaco Canyon sites; however, mean base width and length of these points were significantly larger ($P = 0.05$), and blade length and maximum width were significantly smaller ($p = 0.05$) than the mean of these measurements from other corner-notched points. That is, corner-notched points at Pueblo Alto had larger bases and smaller blades than similar points at other Chaco Canyon sites. We can offer no explanation of this difference.

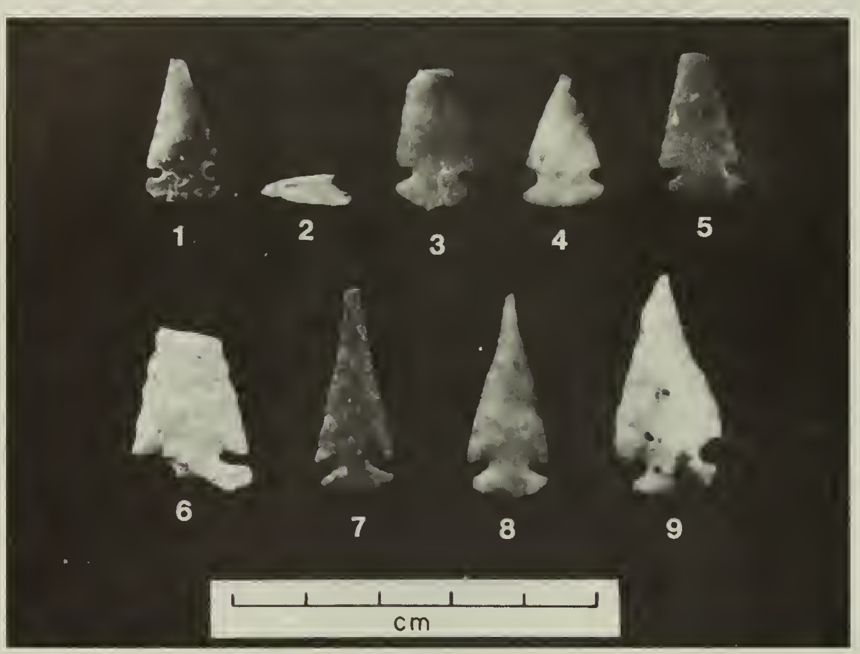


Plate 3.1. Corner-notched arrow points. FS# 1-3414; 2-2877; 3-5052; 4-1140.01; 5-3527; 6-3405; 7-4757.01; 8-4668; 9-19.

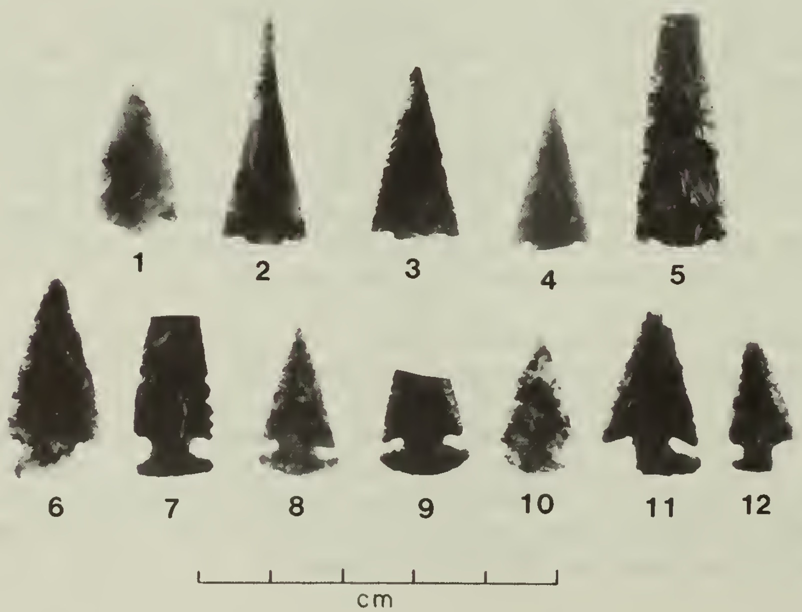


Plate 3.2. Corner-notched arrow point blade fragments. FS# 1-4730.01; 2-4567.02; 3-4232; 4-4259; 5-6273. Corner-notched arrow points. FS# 6-4629; 7-4031; 8-3535; 9-2196; 10-6500.05; 11-4348; 12-3674.

Corner-notched points were made primarily from local cherts and chalcedonies. There was no clear association of any exotic material with any subgroup of corner-notched points, either by size, form, or provenience. Relatively few of these points were made on silicified woods, as compared to the entire population of points at Chaco Canyon, and none were made from obsidian.

Blade fragments that appear to be from corner-notched points (Plate 3.3) do not differ in any formal or metrical way from the complete corner-notched points. The types of materials similarly mirror those seen in complete points; there is no significant difference between the two groups.

There were 43 side-notched points (Plates 3.4-3.8), three times as many as corner-notched forms. The side-notched form is generally somewhat later than the corner-notched form at Chaco; elsewhere in the canyon, points of this form date from about A.D. 1200. The Pueblo Alto points probably date to the early or middle segments of this range. Formally, these points are very similar to other side-notched points at Chaco Canyon, with the following exceptions: At Pueblo Alto, there were relatively more points with straight bases compared to convex bases (the ratio of straight to convex at Pueblo Alto is 1:1; in the population, 1:1.6). At Pueblo Alto, many more points had parallel or contracting edges below the notches than did those at other sites (the ratio of parallel:expanding: contracting in other sites of side-notched points is about 1:1:1; in the group from Pueblo Alto, this ratio is about 5:1:2). There are no significant metrical differences between Pueblo Alto side-notched points and the larger population of such points at Chaco Canyon.

About one-third of the side-notched points were made from exotic materials. The most frequent exotic material was Morrison formation quartzite. In particular, a group of 14 points found in a dense cluster in trash deposits of Kiva 10 has a remarkable proportion of Morrison formation materials. Formally, these points do not appear significantly different from other Pueblo Alto or Chaco Canyon points, yet there context and material type suggest that they form a group. We do not know the nature of the cluster of points; they were found largely in the screen, and we cannot determine if they were part of a decomposed quiver or group of arrows.

Over half of 13 blade fragments thought to be from side-notched points (Plates 3.9 and 3.10) were of exotic materials, a higher proportion than in the complete points. Formally and metrically, the blade fragments are not significantly different from the complete points. However, the differences in materials suggest that broken and complete points may reflect different types of deposition or different functional contexts for the two groups.

It appears that whole and fragmentary condition differ between the earlier corner-notched and later side-notched groups. For corner-notched points, there are approximately as many blade fragments as complete points, whereas for the side-notched group, there are only a third as many

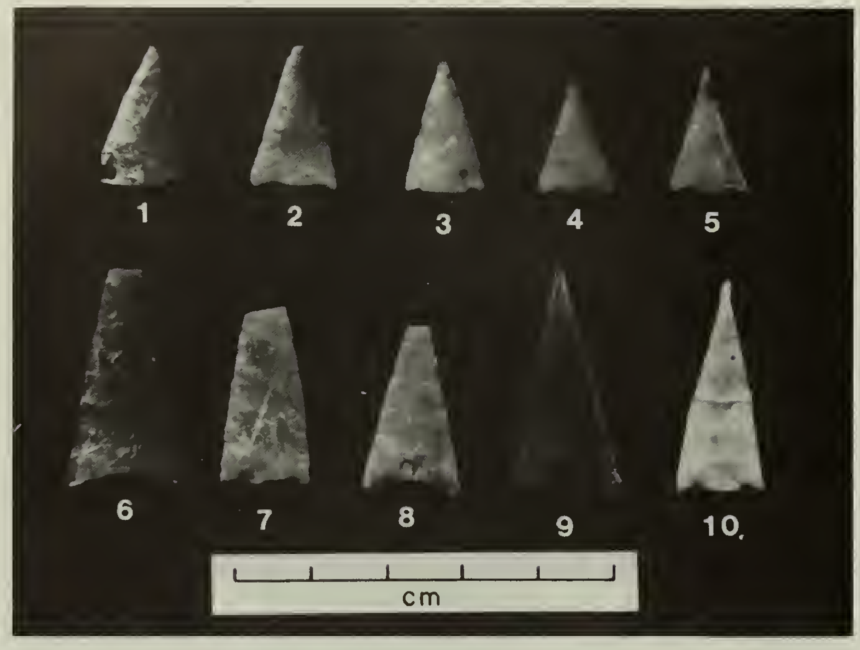


Plate 3.3. Corner-notched arrow point blade fragments. FS# 1-4201; 2-3524; 3-4568.01; 4-4770; 5-2448; 6-6616; 7-4196; 8-4642.01; 9-7247; 10-1135.

Plate 3.4. Side-notched arrow points. FS# 1-6500.06; 2-6500.02; 3-6500.01; 4-6500.04; 5-6501.01; 6-2744; 7-898; 8-6507.01.

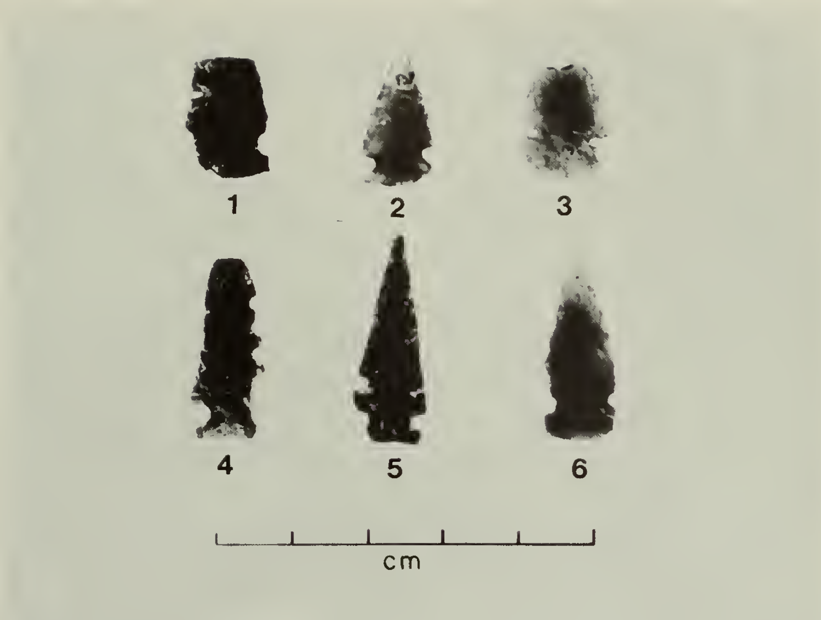


Plate 3.5. Side-notched arrow points. FS# 1-4642.02; 2-2715; 3-6506.01; 4-2593; 5-4060; 6-4617.

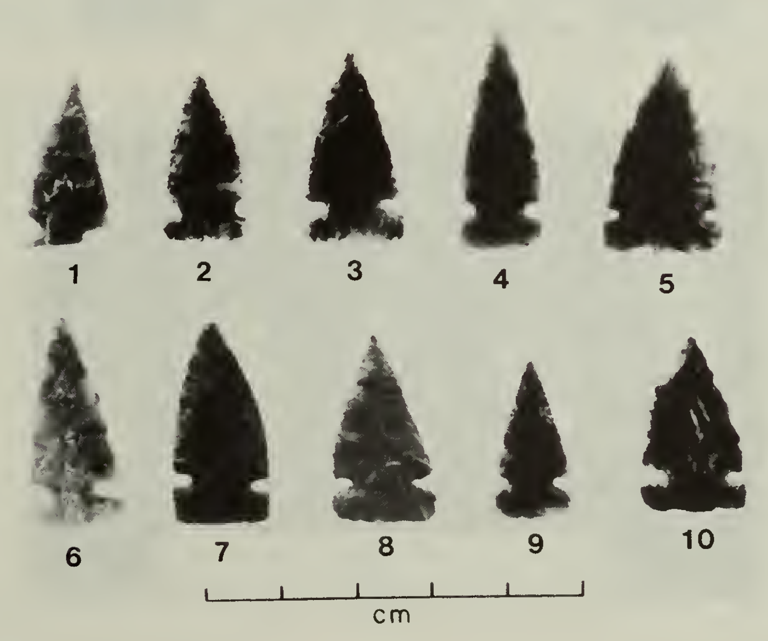


Plate 3.6. Side-notched arrow points. FS# 1-6776; 2-6294; 3-1144.02; 4-6510; 5-6506.02; 6-6500.09; 7-6296; 8-6273.01; 9-6519; 10-874.

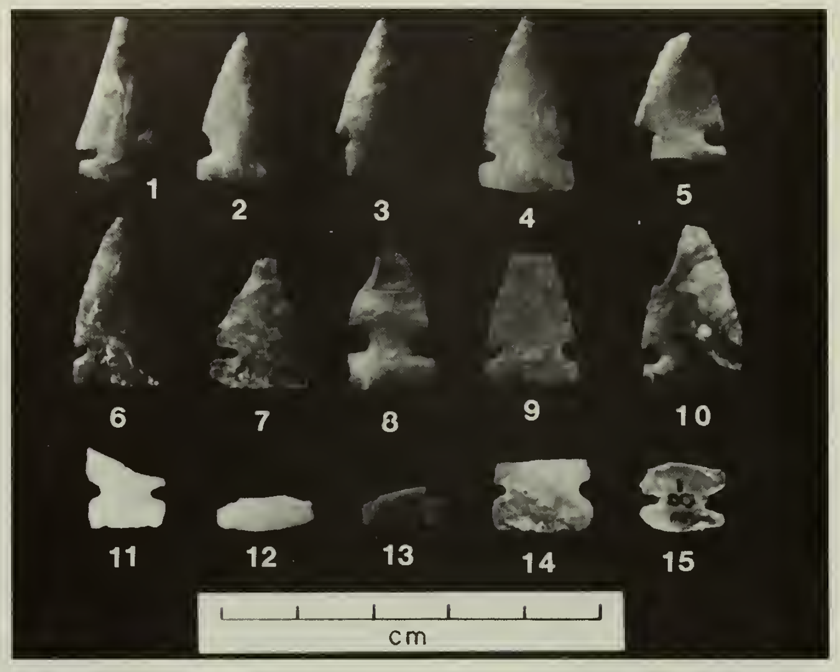


Plate 3.7. Side notched arrow points. FS# 1-4769; 2-616; 3-4565.02; 4-114 5-666; 6-6518; 7-916; 8-3608; 9-5820; 10-4225; 11-3427; 12-3515 14-6507; 15-4627.

Plate 3.8. Side notched arrow points. FS# 1-1140.02; 2-2479; 3-6502; 4-4555; 5-1132.

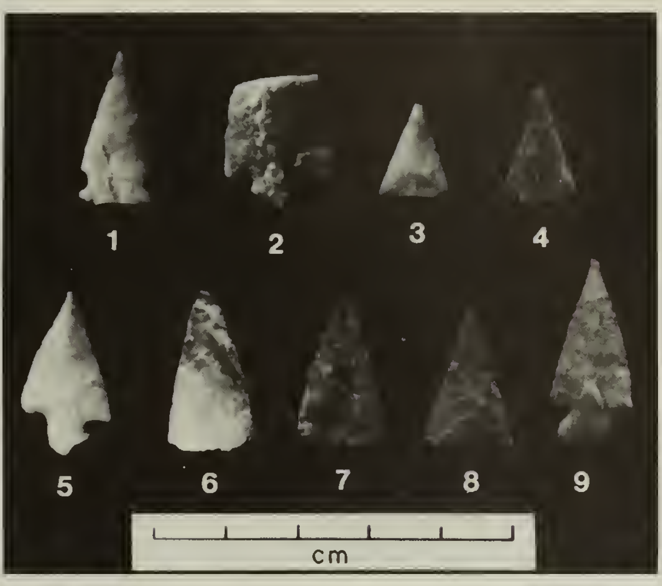


Plate 3.9. Side notched arrow point blade fragments. FS# 1-6503.03; 2-6500.08; 3-4575; 4-4671.02; 5-5489; 6-1136; 7-4400; 8-2467; 9-6500.07.

Plate 3.10. Side notched arrow point blade fragments. FS# 1-4548; 2-2194; 3-4609; 4-6615; 5-2889.

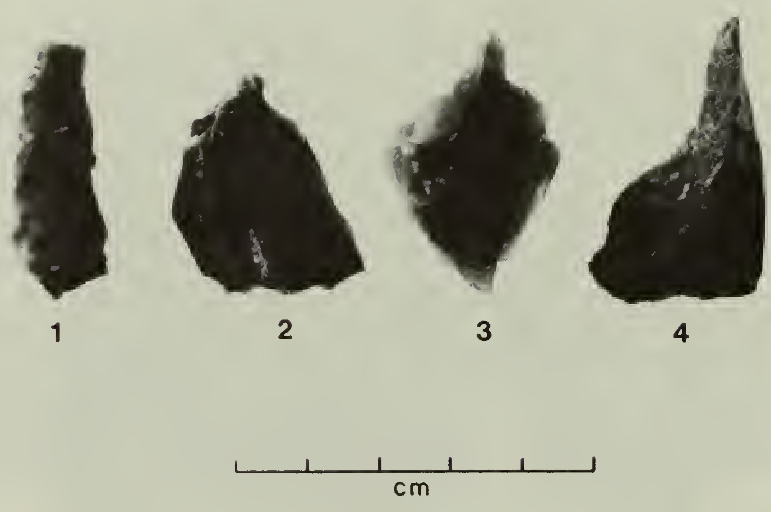


Plate 3.11. Drills and perforators. FS# 1-4318; 2-477; 3-4569.03; 4-6503.02.

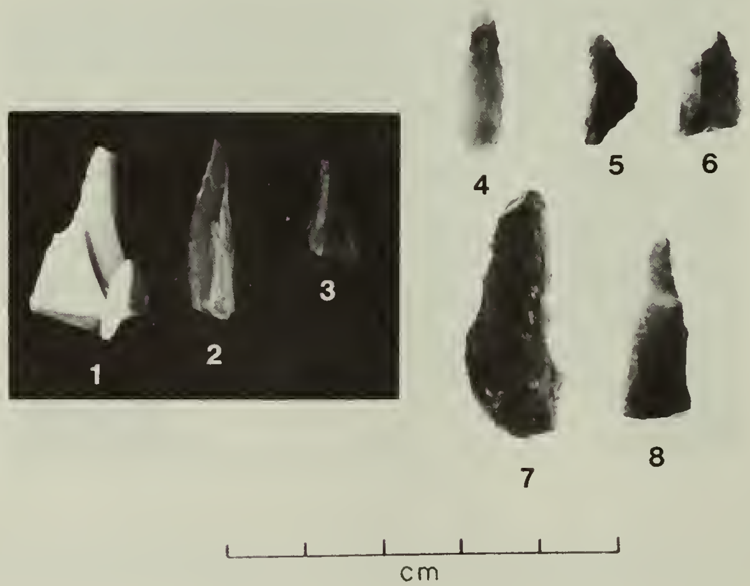


Plate 3.12. Drills and perforators. FS# 1-6503.01; 2-886; 3-6517; 4-4790; 5-4730.02; 6-4569.01; 7-182; 8-4567.01.

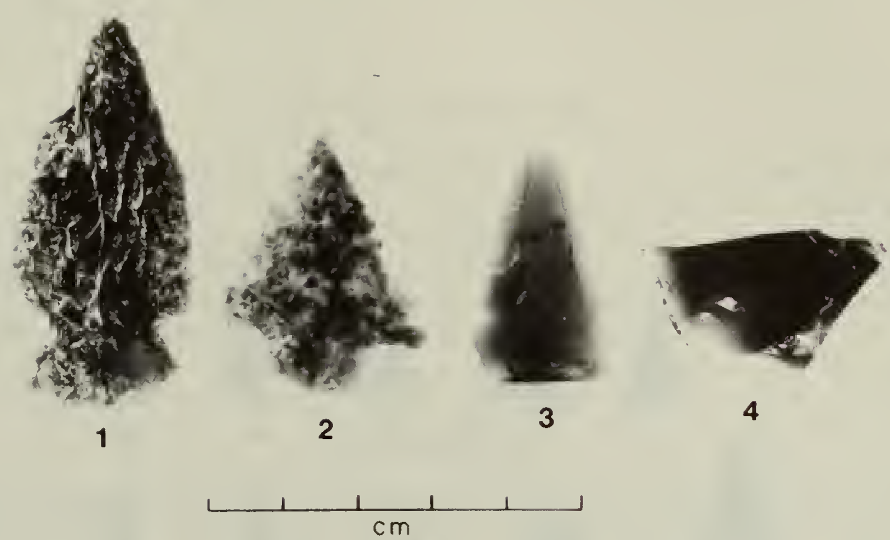


Plate 3.13. Archaic points and large blades. FS# 1-658; 2-4662; 3-6500.03; 4-3499.

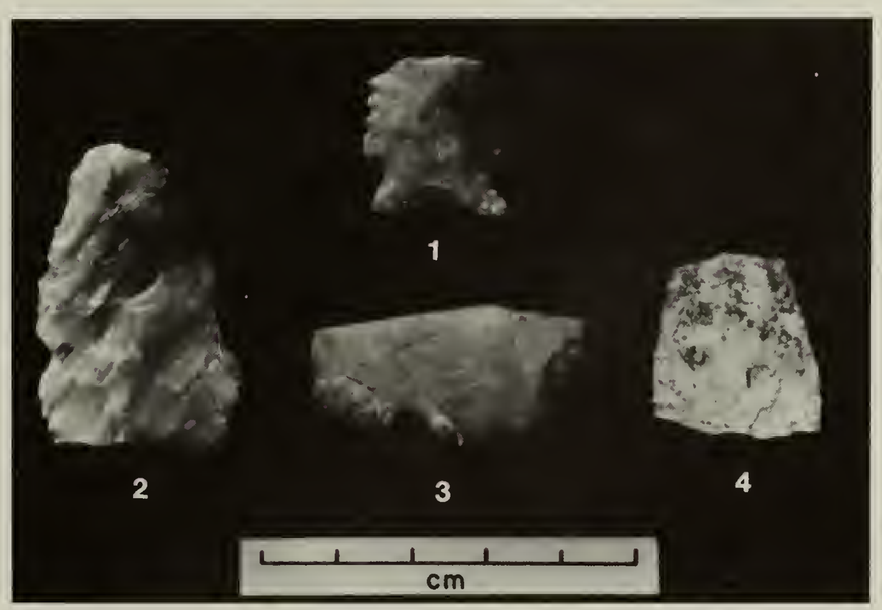


Plate 3.14. Archaic points and large blades. FS# 1-000.01 (Cat #637); 2-921; 3-601; 4-6500.10 (upside down).

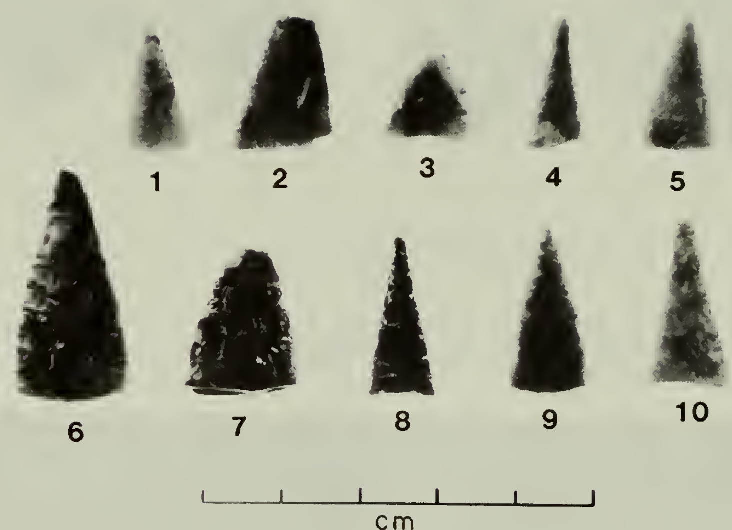


Plate 3.15. Small non-diagnostic tips and blade fragments. FS# 1-6501.02; 2-4757.02; 3-6622; 4-4671.01; 5-6781; 6-4553 (small non-hafted blade); 7-4280; 8-393; 9-6508; 10-4195.

blade fragments as whole points. The difference between the proportions of whole and fragmentary points of side- and corner-notched groups is significant (Chi-square = 7.70, $p = 0.005$; Fisher's exact = 0.006). We suggest that the contexts of point use and discard changed through time: in the earlier period, use and discard introduced relatively many broken points into deposits at Pueblo Alto, whereas during later periods relatively many more complete points were left on site (e.g., in trash deposits at Kiva 10).

Drills and Perforators

Drills and perforators (Plates 3.11 and 3.12) are few (four projections on flakes; four unmodified utilized flakes; and four minimally retouched drills) and were completely undistinguishable from other Chaco tools of this class. Metrically, formally, and materially, there were no significant differences between drills and perforators at Pueblo Alto and those in the larger Chaco Canyon population.

Miscellaneous

Large bifaces (Plates 3.13 and 3.14) and miscellaneous blade fragments (Plate 3.15) are best documented by illustration. Some of these pieces are clearly unfinished; at least two, and perhaps three (Plate 3.13:1,2; Plate 3.14:1), are reused archaic points.

Summary

In summary, the chipped-stone tool assemblage is unremarkable when compared with contemporaneous assemblages at Chaco Canyon and in other districts of the Anasazi area. Perhaps the most provocative finding of their descriptive analysis is the change in context and function of arrow points as reflected by the ratio of whole to fragmentary points. Evidently, more whole points entered archeological deposits later in the site's history than in earlier periods.

Chapter Four

Some Ground Stone Tools and Hammerstones from Pueblo Alto

Thomas C. Windes

Introduction

The remains of ground stone tools were prolific at Pueblo Alto (Table I.1), as they are in every puebloan house site in Chaco Canyon, particularly in the Pueblo II and III periods. Approximately 2,100 pieces of ground stone were recovered from the testing and excavation at Pueblo Alto, but not all of them were analyzed. This chapter covers a variety of tool types recovered from Pueblo Alto that were not analyzed during the initial analyses or did not have sections specifically written for Pueblo Alto.

Ground stone tools entered a long sequence of use upon their initial manufacture. We do not yet know all the formation processes that ground stone pass through before their final discard and eventual recovery by an archeologist. In Chaco Canyon it is clear that ground stone tools had considerable utility and passed through a long chain of use, curation, abandonment, and reuse. Whole metates, for instance, must have been a highly valued item because they were rarely recovered intact during the Chaco Project. The availability of the abundant local sandstone suggests that the value placed on metates resulted from intensive labor required for their manufacture or from cultural beliefs.

These values, however, may transcend a millennium and different cultural groups, which would obscure the formation processes that ground stones underwent. I suspect that ground stones were periodically scavenged from the canyon sites as different cultural groups passed through. We know, for instance, that historic puebloans, and others, have scoured the countryside in search of whole metates for their daughters (e.g., Florence Ellis in Roberts 1958:138) as well as for other prehistoric tools (Hough 1919:271; Russell 1908:109-110). Even the historic Navajo occupation of Chaco Canyon probably resulted in artifact displacement at the prehistoric sites.

Testing at the latest site in Marcia's Rincon, a Mesa Verdean reoccupation, revealed the probable solution for the paucity of whole metates recovered from the several earlier sites excavated nearby by the Chaco Center. The late site was covered with metates and metate fragments, and

we suspect that they were stripped from the earlier sites nearby for building materials (most were associated with the wall rubble at the late site). The reuse of ground stone for construction materials is common in the long-lived sites in Chaco Canyon, particularly in the early A.D. 1100s when it is suspected that a large population reoccupied the canyon (see Volume I, Chapter 11). Concentrations of ground stone tools observed in some excavated sites suggest curation for eventual reuse. Thus, the eventual recovery of much of the ground stone from canyon sites may be biased by considerable displacement from the stones' primary context in both time and space.

The reuse pattern observed for ground stone tools in Chaco Canyon was evident at Pueblo Alto. Few of the early contexts at Pueblo Alto revealed abundant ground stones. The Trash Mound, often a locus for discarded tools, revealed few except for the masses of tools used during the initial building construction. Late contexts, however, spewed forth broken and whole ground stone tools, often in association with trash deposits in abandoned structures, wall fall, and occupation debris left on the roofs or uppermost floors. Thus, throughout this chapter, the reader must keep in mind that tool assemblages attributed to the final occupants at Pueblo Alto may have been partly derived from earlier, abandoned contexts or from curated stocks.

Choppers

Small, hand-held tools with sharp, chipped edges (Plate 4.1A) were recorded as choppers for the field inventory. Only 51 of these were recorded, and they have not been analyzed. Forty were field-recorded for material, with the majority made of sandstone (80 percent), followed by petrified wood (10 percent), quartzite (8 percent), and "calcite" (2 percent). Some of these may have been hafted, although only one was notched or grooved for fastening to a handle. This unusual example came from the Floor 1 fill in Room 110. It was made of a very hard calcite-like material, resembled a small hatchet (Plate 4.1B) with a poll and bit, and weighed 233 g. Hafting notches were evident on one side, and its shape and size suggest that it must have had a handle to be useful. Many choppers were not so definitive but often were made of an irregular chunk of splintery petrified wood or a pebble with several flakes removed from one end.

The largest assemblages were recovered from the Trash Mound (12 of 51, 24 percent) and in structural wall fall (9 of 51, 18 percent). Few were associated with deposits of construction debris (10 percent), and none came from primary floor contexts. It is particularly notable that these tools were practically absent from the floors and floor fill in the multifunctional living rooms in the West Wing despite the abundance of materials there. About half (51 percent) came from late deposits. Overall, it appears that the distribution of those listed in the field inventory was not particularly spatially or temporally informative, except for disproportionate numbers in the late deposits. The amount of earlier

Plate 4.1. Miscellaneous ground stone tools from Pueblo Alto. A. Chopper made of petrified wood (NPS#25465). B. Two views of a hafted chopper from Room 110, Floor 1 fill (NPS#25467, 25469). C. Full-grooved greenstone axe from the Rabbit Ruin (29SJ 390), Room 11 (NPS#31369). D. Full-grooved igneous axe from the floor of Kiva 15 (NPS#32105). E. Notched, 6.7 kg sandstone chopper or crusher from Other Structure 6, wall clearing (NPS#25762-25673).

cultural material in late deposits, however, cautions against definitive statements about the field-inventory list of choppers.

Akins (this volume) recorded 193 abraders with secondary use as choppers that were not listed as choppers in the field inventory. We cannot be sure, however, of the initial function of these tools, although we must presume that the majority of the tools were originally abraders modified as choppers. All of these except three (of quartzite) were made of sandstone. Again, these tools were common in the Trash Mound (37 of 193, 19 percent). Unlike those from the field inventory, small numbers came from the construction debris (8, 4 percent) and the floors in the multifunctional living rooms 103 and 110 (10, 5 percent). They were particularly common in Kiva 15 (12, 6 percent), in the postoccupational fill in Room 103 (25, 13 percent), and in the southern enclosing arc (34, 18 percent); proveniences dating after A.D. 1080. In contrast, these tools were rare in the excavated Central Roomblock rooms, with only 11 (6 percent) recovered from the seven rooms. Overall, 122 of 193 (63 percent) came from late contexts.

We know from other kinds of data that reuse of materials by the early A.D. 1100 inhabitants is notable. The distribution of choppers made from reused abraders seems to confirm the scrounging strategy of the late inhabitants at Pueblo Alto, although it is uncertain to what particular uses these tools were put.

Hafted Implements

Hafted tools of ground stone were rare at Pueblo Alto. Except for a single instance, classic ground or polished hafted tools (e.g., axes, picks, hammers, etc.) were absent. Most of the hafted tools were recovered in association with construction debris buried in the Trash Mound (Layer 3) and are presumed to have been used in the initial shaping of the sandstone masonry used in the early Pueblo Alto construction.

Cutting Tools

Axes are notoriously rare in Chaco Canyon, and those recovered from the Pueblo Alto community proved to be no exception. A full-grooved, ground, greenstone axe (Plate 4.1C), weighing 770 g (121 by 67 by 53 mm), was recovered during wall clearing at the Rabbit Ruin (29SJ 390) along the east wall of Room 11. Greenstone (material type 4526) was favored for many of the axes recovered in Chaco Canyon and probably came from the closest sources: the gravel beds of the San Juan River drainage 75 km away or east of the San Juan in the Brazos Uplift in northcentral New Mexico (Breternitz 1976:12-13).

Another full-grooved axe, weighing 226 gm (105 by 65 by 20 mm), came from the floor of Kiva 15 at Pueblo Alto (Plate 4.1D). It was made of hornblend-diorite, an igneous material also found in the gravel beds of the San Juan River drainage. Both axes came from early A.D. 1100s

contexts and temporally coincide with a fusion of other cultural traits that bear marks of the San Juan Region (see Volume I and H. Toll 1985). Breternitz (1976:19) believes that Chaco Canyon axes increased in frequency during the Pueblo II period during the height of the Chacoan Phenomenon and then declined. Temporal refinements since Breternitz wrote his paper suggest axes were always rare in Chaco until after A.D. 1100. The few recovered from the small sites that predate Pueblo Alto (Breternitz 1976) may have satisfied requirements for harvesting available local wood. After A.D. 900 timber needs increased dramatically with the construction of the greathouses but without a corresponding increase in axe frequency.

Ground stone axes may have served a variety of functions, including the splitting of masonry stone (Haury 1931:53) and roughening metate surfaces (Alfonso Ortiz in Dodd 1976:119; Russell 1908:109), although their presumed initial primary function was for chopping wood (Woodbury 1954:40-41). As the axes became unserviceable for chopping, their function was relegated to hammering. All those examined by Breternitz (1976) and most of those recovered by other investigators had ended their lives as hammers or mauls.

Judd (1954:239) was perplexed by the paradox of thousands of roofing timbers used in Chaco Canyon and the paucity of axes, but we are now sure that most of timbers were harvested far from Chaco (see Volume I, Chapter 7; Betancourt et al. 1986). In the San Juan Region, where forests are commonplace, axes were plentiful throughout the Anasazi occupation (e.g., Cattanach 1980:254; Hayes and Lancaster 1975:148; Martin 1939:Figures 114-116; Morris 1919:22; Nordby 1974:Table 35; Rohn 1971:212). The paucity of axes in Chaco, therefore, seems to be related to the paucity of prehistoric forests in the vicinity.

How is the increase of axes in the early A.D. 1100s to be explained, then, if there was not a coincidental increase in trees? The paucity of axes at Pueblo Alto is probably real and not biased by the sampling strategy. The vast excavations at Pueblo Bonito and Pueblo del Arroyo, for instance, yielded a mere 15 and 8 axes, respectively (Judd 1954:239, 1959:141). All were made from igneous stone common to the San Juan Region, and, at Pueblo Bonito at least, all occurred in late contexts. Rather than reflecting a change in local technology, axes may have been brought by people from the San Juan Region during the population influx in the early A.D. 1100s. Some ritual significance may have been attached to axes even though they had little utility in Chaco. At Hopi, axes were highly prized and passed down through many generations (Woodbury 1954:41-42), and they were often associated with kivas. Interestingly, the sole specimen from Pueblo Alto came from a kiva. In addition, they had great value for altar equipment at Hopi and were actively collected from prehistoric sites (Hough 1919:271). In the historic past, axes were valuable enough to be used to purchase a wife (Bourke 1962:69-70). If axes had similar values in the prehistoric past, it is logical that they would have been carried to new locations when their owners moved.

On the other hand, axes may have been particularly useful in Chaco in the early A.D. 1100s because of extensive, new, small-house construction

and remodeling. A suggested decline in greathouse and small-house occupation in the late A.D. 1000s (see Volume I, Chapter 11) would have left many structures vacant, but these roofs were salvaged later for timbers and firewood. Better provenience and temporal information would greatly assist in verifying or refuting these possible scenarios, however. The use of axes in Chaco may prove informative about timber resource procurement strategies and timber depletion. The paucity of axes throughout the occupation in Chaco suggests that wood resources were always scarce locally.

Besides the hafted masons' tools (see below), Pueblo Alto produced only a few other hafted tools. One was a large (6,640 gm, 33 by 16 by 10 cm) chunk of Cliffhouse sandstone, shaped by flaking and pecking, which had two opposing notches pecked into its sides (Plate 4.1E), although it may never have been hafted (Breternitz 1976:11). Both ends were battered and broken. It was recovered, with numerous hammerstones, from the trash fill of Other Structure 6 during wall clearing. Odd sizes of notched sandstone tools with flaked or battered bits occur sporadically at sites in Chaco Canyon. Their rarity and variation in size and shape suggest that they were used for specific, unique tasks of short duration. These stones are generally made of soft sandstone and would have been useful only in crushing or chopping soft materials. Otherwise, the labor invested in their making probably would have exceeded the labor required for their functional task if the tools had been used on hard materials.

Hafted Hammers

Most hafted tools were recovered from the deposits of construction debris at the site and are presumed to have been used in the initial shaping of the sandstone masonry in the early rooms. These tools (Plate 4.2) were made of the same very hard, light gray, indurated sandstone of local origin that comprises the earliest greathouse masonry at the site. These hafted tools were not included under the hammerstone/abrader discussion, although they are similar. Typically, these tools exhibited many of the same wear characteristics found on hammerstone/abraders, particularly ground faces and battered edges (Table 4.1).

Forty-nine "hafted" tools are discussed here. Six had pointed, pick-like tips and were probably hafted despite the lack of notches. All six were wedge-shaped or irregularly shaped, as were the majority of the pick-like tools with notches (6 of 9). The remainder (34) were hafted hammerstone/abraders, which had a high frequency of ground faces (30 of 34) and/or battered ends (33 of 34). The 34 were varied in shape but were comprised largely of wedge and irregular shapes (41 percent) compared to the unnotched hammerstone/abraders (28 percent). A single notch was evident on 16 of the 34 tools, although the remainder had 2 notches except for 1 with 4 notches. The quality of the notches and their irregular number per tool suggest hafting served only an expedient, short-term purpose. Notches were so rough that we must question the practicality of hafting a tool with a handle that probably would have loosened or broken after some use. The tools must have been quickly made, used, and discarded.

A

B

C

Plate 4.2. Mason's tools from the Trash Mound construction debris. A. Hafted hammers recovered from TT 1 in Grids 99 and 127, Level 7 to sterile sand (NPS#24558a). B. Tools from TT 1 in Grids 43 and 71 at 1-m depth to sterile sand (FS#4628). All are hammerstones/abraders except for the two notched hammers in the upper right corner. (NPS#24459a). C. Hafted hammers from Trash Mound Layers 2 through 4. Specimen from the top row, second from the right, is, however, from Major Wall 1 at the Blockhouse (NPS#24563c).

Table 4.1. Hafted hammerstone/abrader and pick summary statistics.

Type	Number whole	Mean Weight (g)	sd	CV %	Minimum-Maximum	Battered Edges (%)	Ground Faces (%)	Ground Edges (%)	Chipped Edges (%)
Notched hs/a	34	302.8	147.7	48.8	125.9 - 627.0	97	87	21	9
Notched pick	9	115.8	167.8	144.8	233.3 - 5,500.0	67	67	11	0
Unnotched pick	6	494.3	312.2	63.2	164.7 - 1,021.2	100	33	17	33
All notched-Trash Mound, Layer 3	19	431.0	347.1	80.5	125.9 - 1,493.2	89	89	32	5
Notched hs/a Trash Mound, Layer 3	16	310.3	158.6	51.1	125.9 - 501.1	94	88	25	6
All notched-Room 142, Fl. 2	6	347.5	195.1	56.2	161.2 - 644.7	100	83	17	0
All picks-Room 142, Fl. 2	4	440.6	169.6	38.5	233.3 - 644.7	100	75	0	0

The pick-like tools were noticeably heavier than others, both notched and unnotched (Table 4.1). The increased leverage through hafting, the concentration of force at the small end of the pick, and the heavier weight would have enabled these tools to be used for the initial fracturing of the masonry stone into useable fragments. The sharp and rough edges left after the initial shaping of the masonry stone presumably were battered and ground smooth with the lighter hammerstone/abraders. Worn-out picks apparently saw secondary use as hammers and abraders.

Distribution

The distribution of the hafted masons' tools indicates that they were used primarily during the initial site (Stage I) construction (see Volume I, Chapter 6). Layer 3 in the Trash Mound yielded the majority of these tools (19), followed by those from Wall Trench 1 in Room 142 (6) in the Central Roomblock. The number of hafted tools to hammerstone/abraders is about the same in the Trash Mound and the Central Roomblock rooms (139 and 142) that had large assemblages of construction tools (12, 17, and 18 percent, respectively). Nevertheless, compared to the other areas with large assemblages of masons' tools, the Central Roomblock and Trash Mound were the most similar.

Assemblages in the West Wing had a paucity of hafted tools compared to the Trash Mound and Central Roomblock. Because the West Wing was built later than the Central Roomblock, masonry-shaping techniques may have differed some between the two areas. Wall masonry veneers in the excavated Central Roomblock and West Wing rooms were not always similar, and the amount of construction debris left in the two areas differed. There appears to be a decrease in the amount of spalls used in veneer construction in the West Wing walls, which might have resulted in the paucity of debris in the West Wing rooms. On the other hand, unlike the Central Roomblock rooms, much of the final stone dressing may not have been done in the West Wing rooms, but, either way, I believe that the differences in the hafted tool frequencies reflect differences in construction techniques.

Percussion Tools (Hammers)

Hand-held tools used for battering are commonplace in Anasazi sites. These are commonly recognized as spherical pebbles battered at the ends and designated as hammerstones. Tools used for battering, however, were not limited to those cobble-shaped stones that fit easily into the hand. A wide assortment of stones, often discarded tools or tool fragments, were used as hammers, probably for a variety of tasks. Thus, manos and mano fragments, polishing stones, abraders, and worn-out axes, to name a few, may all have served some final use as a battering agent. Systematic investigation of hammers that incorporates all varieties of reused tools under a single umbrella of inquiry is rarely accomplished and, unfortunately, was not done for the present project.

In most accounts, hammers are described as multifunctional tools that, when compared to historic analogs, were used for a great variety of tasks. Although such tools were profuse at Pueblo Alto, their distribution at the site suggests that most were used for a limited set of tasks. We encountered one type of hammer at the site that had been rarely observed from our small-site excavations, and its prolific presence at Pueblo Alto caused some confusion in assigning it a consistent field classification until we agreed on the term hammerstone/abrader (by Marcia Truell). Its descriptive name derived from evidence that percussion and grinding were primary functions of this tool. The field impression that these tools differed from hammerstones can be demonstrated solely by their respective distributions within the site, although material, form, and wear patterns also dictate functional differences between the two tool types.

The analysis of hammers presented here follows the massive effort generated for other artifact categories and suffers somewhat from an inability to properly cull and re-examine all tools that may have comprised these important classes. In addition, the study focused on the distribution of these tools in the site and on their functional interpretation that we hoped would widen our perspective of events at Pueblo Alto and the tasks carried on there.

Hammerstones

A broad range of ethnographic uses have been attributed to hammerstones (e.g., Gifford 1940; Hough 1919:270-271), including plant processing, roughening (sharpening) metate surfaces, shaping masonry, striking chipped stone flakes from cores, and breaking bone. Consequently, hammerstones have gained a widespread reputation for multipurpose use in prehistoric sites (e.g., Haury 1976:279; Judd 1954:118; Woodbury 1954:91), which at times has led to their being dismissed as useless for understanding human behavior (e.g., Haury 1976:279). Typically, hammerstone contexts in excavated sites are uninformative regarding specific tool tasks (e.g., McKenna 1984:245). Although it is often true that hammerstones are ubiquitous in sites, their spatial and temporal distribution at Pueblo Alto suggests use for only a few specific tasks.

A preliminary report was completed for the hammerstones recovered in 1976 from Pueblo Alto (Wills 1977), but most of the 818 hammerstones from the site have not been analyzed. Fortunately, material type was recorded for the stones during the field inventory so that a listing of the various materials used for hammerstones is possible for the entire collection (Table 4.2). Forty-five others were analyzed as abraders with secondary percussion use (Akins, this volume), but most of these (33; 73 percent) were sandstone and not relevant here. The remaining 12 of hard siliceous stone (8 of quartzite) were analyzed only as polishing stones (e.g., abraders) despite evidence of battering. These 12 are not included in this discussion.

Table 4.2. Hammerstone material frequency at Pueblo Alto.

Material type	Frequency	Percent	Percent without unknown and sandstone (n = 723)
unknown	60	7.0	-
Chert/chalcedony:	21	2.5	2.9
1010 (fossiliferous)	5	0.6	0.7
1020 (miscellaneous)	1	0.1	0.1
1021 (miscellaneous)	1	0.1	0.1
1040 (Brushy Basin)[a]	1	0.1	0.1
1042 (Brushy Basin)[a]	2	0.2	0.3
1051 (white, black inclusions)	1	0.1	0.1
1053 (clear, black inclusions)	5	0.6	0.7
1060 (jasper)	1	0.1	0.1
1073 (yellow brown)	1	0.1	0.1
1080 (Washington Pass)[a]	2	0.2	0.3
1235 (moss jasper)	1	0.1	0.1
Splintery silicified wood:	364	42.6	50.3
1100 (undifferentiated)	9	1.1	1.2
1109 (light)	4	0.5	0.6
1110 (dark)	312	36.5	43.2
1111 (rodlike inclusions)	39	4.6	5.4
Silicified wood (chert):	124	14.5	17.2
1112 (dark)	49	5.7	6.8
1113 (light)	56	6.6	7.7
1120 (red)	5	0.6	0.7
1130 (palm wood)	4	0.5	0.6
1150 (jasper)	10	1.2	1.4
Silicified wood (chalcedonic):	27	3.2	3.7
1140 (light)	8	0.9	1.1
1141 (light, black inclusions)	1	0.1	0.1
1142 (light, variegated)	14	1.6	1.9
1145	4	0.5	0.6
Sandstone:	71	8.3	-
2000 (undifferentiated)	63	7.4	
2030 (cobble)	3	0.4	
2123 (Cliffhouse formation)	1	0.1	
2124 (Cliffhouse formation)	3	0.4	
2126 (Cliffhouse formation)	1	0.1	
Quartzitic sandstone:	32	3.7	4.4
2200 (miscellaneous)	4	0.5	0.6
2202 (Nacimiento)[a]	28	3.3	3.9
Zuni shale:			
2652 (white)[a]	1	0.1	0.1
Limestone:			
2700 (undifferentiated)[a]	1	0.1	0.1
Granite:			
3100 (undifferentiated)[a]	1	0.1	0.1
Quartzite:	149	17.4	20.6
4000 (undifferentiated)	11	1.3	1.5
4001 (white)	3	0.4	0.4
4002 (gray)	6	0.7	0.8
4005 (miscellaneous cobbles)	129	15.1	17.8
Quartz:			
5010 (colorless)	3	0.4	0.4
Total	854	99.8	99.7

[a]Not local to the Chaco area (see Cameron, this volume).

Two attributes separate the commonly known hammerstones from hammerstone/abraders (see below) in the field: material and wear. Hammerstones in sites dating before A.D. 1000 were predominately of siliceous materials (e.g., cherts, chalcedonies, and quartzites) exhibiting fair to good fracturing qualities, although used for battering purposes that left a surface dulled by concussion marks (Wills 1977). These tools were obtained primarily from local materials (e.g., Ojo Alamo gravels) that may have become exhausted after centuries of use. By the A.D. 1000s, a majority of hammerstones were formed from chunks of splintery, petrified wood also obtained in the general Chaco Canyon vicinity. Although the shift in hammerstone materials may reflect the changing availability of sources, it may also suggest changing technologies. The petrified wood hammerstones and the debris from their use have been found in association with the debris from bead making activities in Chaco at Pueblo Alto (Mathien, this volume) and 29SJ 629 (Cameron 1982) that suggest their use in the initial working of ores from which the beads were made. In addition, hammerstones of materials harder than petrified wood were associated with the mealing bins in Room 110 (see Volume II), where they were probably used for roughening (sharpening) the use surfaces of metates and manos.

Morphology

Wills (1977:24) argued for two kinds of Chacoan hammerstones on the basis of morphology--angular and spherical--but only one is predominant at Pueblo Alto. Angular hammerstones comprised 95.4 percent of the 1976 total (n = 176), the highest relative frequency for any of the eight canyon sites analyzed. Of the three small-house sites examined that nearly overlap Alto in time, only 29SJ 629 had a similar proportional morphology. The other two [29SJ 627 and 29SJ 1360 (McKenna 1984)] had nearly three times as many spherical stones as did Pueblo Alto and 29SJ 629. The difference might reflect, in part, the shift from dominance of quartzite cobbles to dominance of splintery, petrified wood hammerstones.

Morphology is an important clue to hammerstone use. Angular stones, comprising the vast majority of the Pueblo Alto hammerstones studied by Wills, had sharp or irregular edges and were made predominantly from petrified woods. The fracturing characteristics of petrified woods generate sharp edges when the stones are broken during use. The woods, particularly the splintery variety (material types 1109 and 1110), can be considered self-sharpening materials that are well-suited for roughening metates and manos.

Spherical stones, on the other hand, are not useful for sharpening (roughening) grinding tools because their rounded surface disperses the point of impact on flat surfaces. Experimental studies by Dodd (1976, 1979) not only revealed the inability of spherical hammerstones to sharpen tools but also the physical pain caused to the user. Instead, such stones are more efficient in shaping stone. Because quartzite is typically found as pebbles and cobbles (e.g., often water-rounded into a spherical shape) and is a tough, durable material [7.0-7.5 on Mohs scale (Dodd 1976:94)], it may have been favored for shaping and breaking rather than sharpening

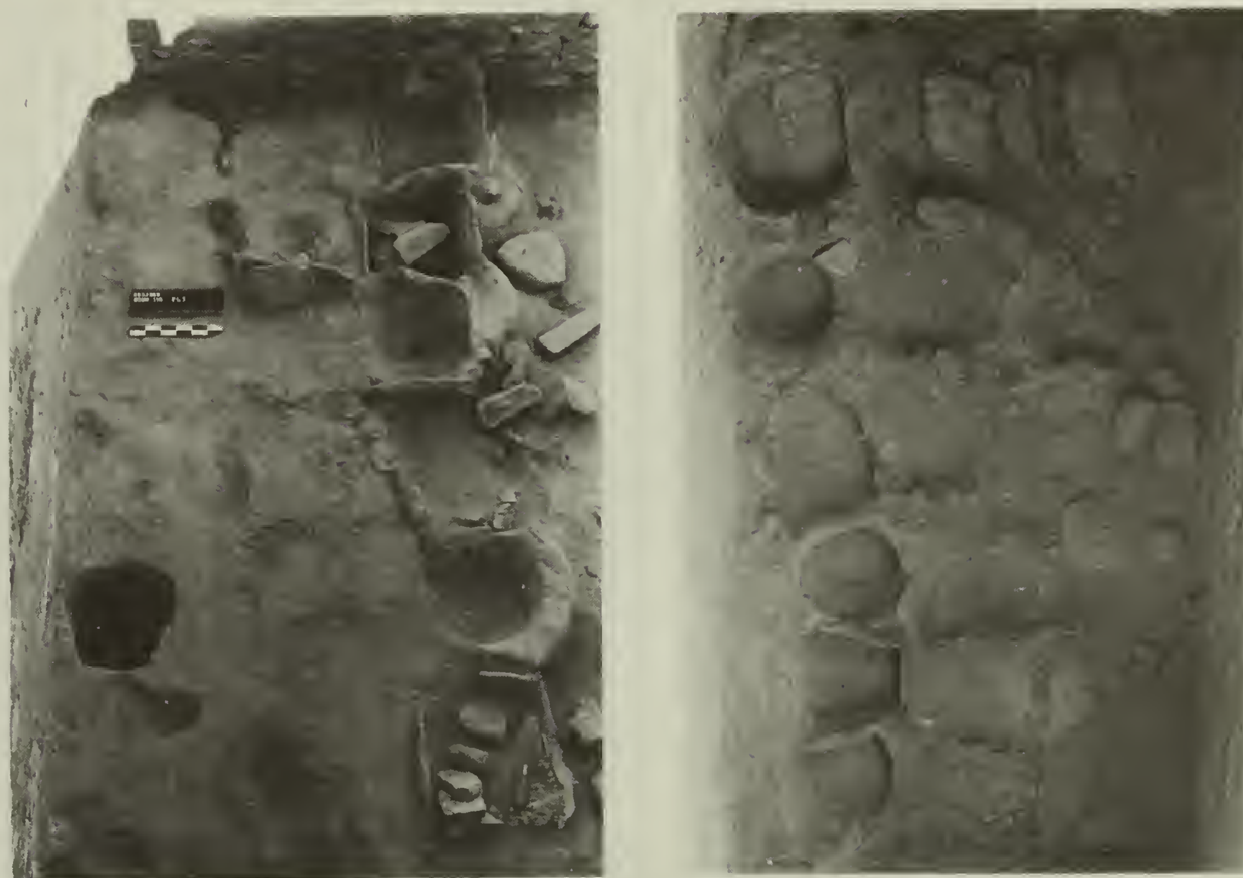
stone. Despite quartzite's lack of use as a material for the Pueblo Alto hammerstones, it was the dominant material associated with deposits of hammerstone/abraders and construction debris, where the shaping of stone must have been a primary task. Quartzite's association with mealing bin tools, however, also suggests that a few quartzite hammerstones were kept for final-dressing of new manos and metates that replaced broken or worn-out tools. Based on weight, a t-test suggested that there was no difference between those quartzite hammerstones associated with mealing bins and those associated with construction debris.

Distribution

At first glance, only a single location at Pueblo Alto revealed numerous hammerstones left in situ from a primary work task. Twenty were found in and around the six mealing bins in Room 110 (Plate 4.3) and constitute an assemblage probably used for shaping and sharpening grinders. Almost the entire allotment of hammerstones (16 of 20) from the room floor (Plate 4.4) were found associated with the mealing bins. Nine of these were left in a tight cluster next to Mealing Bin 6 (MB 6). Another 11 hammerstones were recovered from contemporary pits in the floor, and 6 of these tools came from 2 pits (OP 22 and OP 35) next to the mealing bins. Proximity of the tools to the bins, therefore, makes a strong case for use of these tools with grinding activities (see A Mealing Bin Work Area, below).

This interpretation is strengthened by examination of the hammerstone distribution in other rooms. Nearby Room 103, a living room similar to Room 110, revealed two sets of mealing bins (on Floors 2 and 3), although these had been dismantled. Only 3 hammerstones came from Floor 2--one next to the dismantled bins and 2 others in a slab-lined box some distance away. Floor 3, however, illustrates the inferred relationship between grinding activities, hammerstones, and other tools. The 3 former bins were located in Grids 19-20 and 23-24. All 8 hammerstones from the floor came from the same area or from adjacent grids, as well as all the metate (11) and mano (6) fragments and whole manos (7) recovered from the floor. Some of the manos also revealed secondary use as abraders. Most of the tools were found in the same locations as those in Room 110; the manos were in and next to the bins, and the hammerstones were concentrated off to the east and northeast side of the easternmost mealing bin.

Lithic debris from Floor 3 also confirms the implied association. The majority of the debitage (25 of 30 pieces, 83 percent) came from the same grids as the tools, an area covering approximately 38 percent of the room. In addition, the material types were the same as types comprising the hammerstones, with the majority made of splintery silicified wood (60 percent of the flakes in the bin area and 88 percent of the hammerstones). This implies that the waste flakes were derived from hammerstone use and that the hammerstones were used in the same areas in which the flakes were found. Clearly, an assemblage of tools, used during the mealing process, and their byproducts were left behind in the mealing bin area when the floor was abandoned.



A B

Plate 4.3. A set of six mealing bins in habitation Room 110, Floor 1. Note the numerous manos and hammerstones in association. The metates had been removed. A. Area stripped to Surface 7 (NPS# 16384). B. Area stripped to Top Surface. Note manos in catch basins. 30-cm north scale (NPS#15154).

Plate 4.4. Hammerstones on the floor around the mealing bins in Room 110 at Pueblo Alto. FA = floor artifact. A. FA 9. B. FA 13. C. FA 18. D. FA 26. E. FA 28. F. FA 29. G. FA 30. H. FA 31. (NPS#25472-25479)

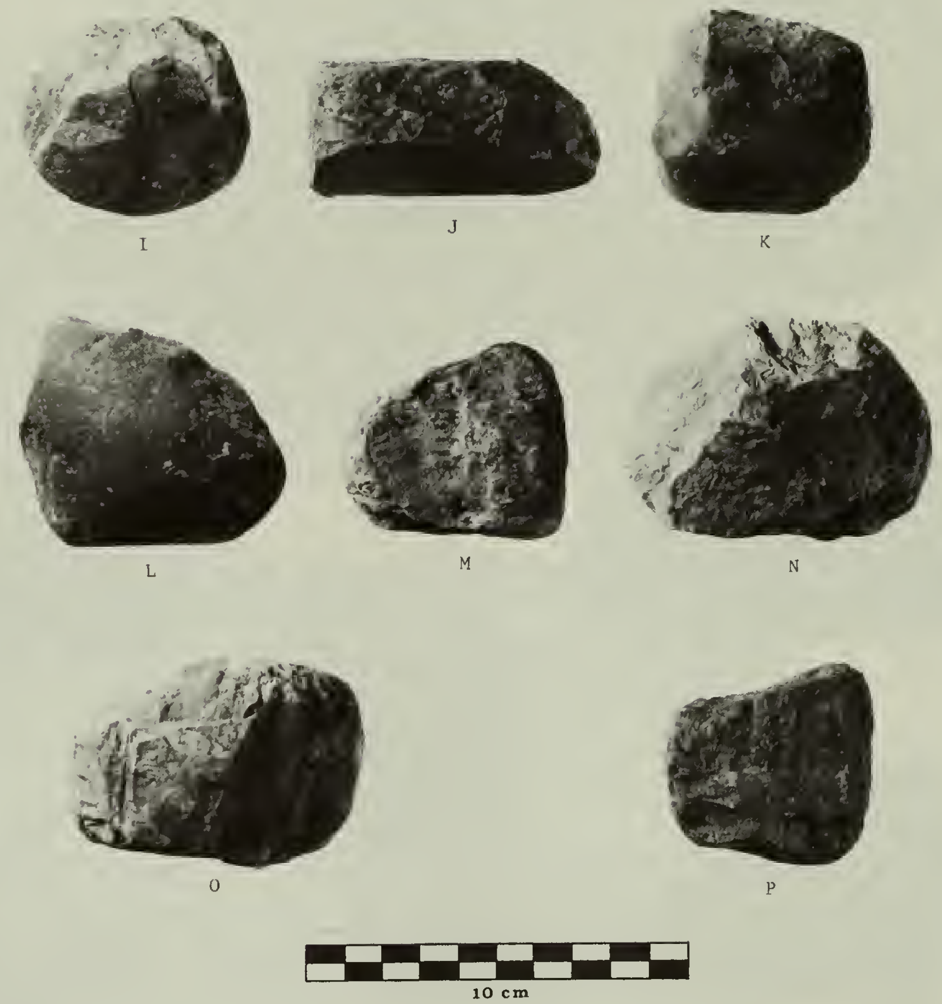


Plate 4.4. (concluded) I. FA 32. J. FA 33. K. Mealing Bin 2 fill (HS#1). L. Mealing Bin 2 fill (HS#2). M. Mealing Bin 3 fill (HS#1). N. Mealing Bin 3 fill (HS#2). O. Mealing Bin 3 fill (HS#3). P. Mealing Bin 4 floor. (NPS#25480-25486)

Floor 4 in Room 103 presents a different picture. The floor use has been interpreted as one for construction activities because of the amount of construction debris present and the absence of hearths and mealing bins. It is one of the few areas in the site where there is a mixture of numerous hammerstones (9) and hammerstone/abraders (9). The presence of the hammerstones appears to be an exception to the evidence for construction activities. Two of the hammerstones were quartzite, a material that may have been favored for masons' tools (although also associated with mealing bins), but the others are of the same materials and weight as those associated with the mealing bins. The distribution of the hammerstones is not as clustered as those observed on Floor 3. Only 6 of the 9 (67 percent) came from the same grid areas as those on Floor 3, although we know that the mealing areas could be shifted, as evidenced by their location in Grids 11-12 and 14-15 on Floor 2. All four sets of bins at Pueblo Alto were in the south half of the room, whereas 78 percent of the hammerstones from Floor 4 occurred there.

Lithic debitage was dispersed across Floor 4. Only 18 of 48 pieces (38 percent) occurred in the same area that was dominated by probable hammerstone flakes on Floor 3, exactly proportional spatially to the total room area. When the weight of the flakes is considered, 65 percent occurred in the same area. Only 37 percent of the debitage was of the same material as the hammerstones. No manos or metates were recovered from Floor 4. Thus, we are unable to associate the hammerstones on Floor 4 with specific mealing activities. Nevertheless, the concentration of hammerstones in the southern grids suggests that some meal preparation may have taken place in the same area that was later reserved for grinding activities on later floors. The overwhelming evidence of construction activities, the lack of grinding stones, and the probable high rate of sharpening needed to maintain grinding tools [every 5 days according to Bartlett (1933:4)] may be consistent with an episode of short-term grinding on portable metates that were removed after the masons completed their work.

Other concentrations of hammerstones did not exist at Pueblo Alto except in trash deposits. The excavated 7 rooms in the Central Roomblock yielded few hammerstones (16), with the majority (10) recovered from the postoccupational fill above the uppermost floor. No more than one was recovered from any single floor except for a pair associated with the construction debris on the lower floor of Room 139.

Hammerstones were prolific in the Trash Mound (n = 317, 39 percent of the Pueblo Alto total) and similar in material and weight to those associated with the mealing bins in the living rooms. Aside from the Trash Mound tools, the majority of hammerstones were recovered during wall clearing. Few, however, came from the postoccupational fill in the primary rooms and kivas in the East and West Wings and in the Central Roomblock. Mano and metate distribution suggests that some mealing activities took place on the old rooftops. Multitudes of hammerstones, together with other discarded tools including manos and metate fragments, came from the late structures in the plaza enclosing arc and those butted against the

old rooms. The amount of debris found in the arc rooms suggests that the rooms became major centers for trash discard just before the abandonment of the site. Thus, the mealing loci can not be pinpointed in the arc area, although I suspect that the loci were nearby.

A peculiar concentration of hammerstones and hammerstone fragments occurred in the refuse of Other Structure 4 (a long, narrow room in the enclosing arc), along with several mano and metate fragments. The vast majority of these hammerstones were made of splintery petrified wood (material 1110, 48 of 53 pieces) and had a mean weight of only 80 g apiece (sd = 47.3, CV = 59 percent), in contrast to whole hammerstones at the site (Table 4.3). The bulk of the lithic debitage from the same provenience, however, was composed of different materials. Of the 29 flakes, only 3 large pieces (weighing a total of 136.9 gm) were made of the splintery wood. It appears that all the splintery wood pieces could have come from the same activity, but whether they were used on manos and metates cannot be discerned. Associated ceramics suggest that the debris was discarded in the early A.D. 1100s.

Summary

Hammerstones were made from a number of materials, but were dominated by splintery petrified wood, which is locally available. Although hammerstones were prolific at Pueblo Alto and found in a variety of contexts, the majority recovered from floors were associated with mealing bins. The similarity of the hammerstones recovered from trash deposits with those around mealing bin areas and the lack of the tools in contexts other than food preparation suggest that most were used for a few specific tasks and then discarded. Thus, the vast majority of hammerstones from Pueblo Alto probably were used specifically for sharpening and shaping the grinding tools used for food preparation and were not used for a myriad of different tasks across the site.

Hammerstone/abraders

During excavation at small Chacoan sites in the early 1970s, an occasional discoid-shaped stone, nicely fitting the palm of the hand, battered on the edges, and ground smooth on the flat sides was recovered (Plates 4.5A and 4.6-4.9). These stones, however, were prolific at Pueblo Alto, although they are rarely reported in the archeological record. They are probably unique to Chacoan sites as a byproduct of the architectural craftsmanship for which the Chacoan Anasazi are justly famed. In earlier greathouse reports the tool class has not received even passing reference except at the Salmon Ruins (Shelley 1978?). The mundane characteristics of the tool class apparently garnered no recognition from previous investigators, who had a wealth of eye-catching material to report (e.g., Judd 1954, Pepper 1920). Thus, a description of these tools is presented here to facilitate recognition and additional investigation into their role and use within greathouse construction episodes.

Table 4.3. Hammerstone weight (g) statistics for selected proveniences.

Provenience	Number whole	Mean	sd	CV %	Minimum-Maximum
Room 103, Floor 3	6	188.1	99.6	53.0	75.0 - 303.3
Room 103, Floor 4	7	182.6	94.4	51.7	104.7 - 367.5
Room 110, all	42	231.8	155.3	67.0	82.8 - 871.4
Room 110, around MBs	15[a]	230.9	168.2	72.8	82.8 - 785.9
Room 110, at MBs (1110 & 1113)	10	204.6	77.8	38.0	82.8 - 329.5
Room 110, at MBs (4000s)	3	400.1	335.1	83.8	180.5 - 785.9
Wall clearing (all)	142	170.6	162.8	95.4	7.0 - 975.0
All (1976 season)	174	168.8	165.4	97.9	7.0 - 1037.0
Trash Mound, Layer 4	13	164.5	83.5	50.7	59.1 - 362.6

[a]Five other whole hammerstones could not be relocated for measurements.

Plate 4.5. A. Hammerstone/abrader recovered near Mealing Bin 6 in Room 110 as Floor Artifact 11 (NPS#25531-25532). B. Sandstone core, weighing 3.7 kg, recovered from the Trash Mound construction debris (Layer 3) in Grids 15, 43 and 71 (NPS#25541, 25545).

Plate 4.6. All of the hammerstone/abraders recovered from Layer 7 above Surface 2 in Room 112 (NPS#24556c).

Plate 4.7. All of the hammerstone/abraders recovered from Layer 7 above Floor 2 in Room 229 (NPS#24555a).

Plate 4.8. Hammerstone/abraders discarded in the blockhouse fill along Major Wall 1. 10-cm scale (NPS#24560a).

Plate 4.9. All of the hammerstone/abraders found scattered on the surface to the east and north of the Parking Lot Ruin. 10-cm scale (NPS#54562).

Hammerstone/abraders were first discovered in quantities at Pueblo Alto as we cleared the wall rubble bordering the room walls and from the surface of the parking lot where the foundations of a small house, designated the Parking Lot Ruin (see Volume II), were found (Plate 4.9). Later, the tools were found to be common in construction debris deposits (Plates 4.2B, 4.6-4.7). There was no consistent label applied to these stones at first; therefore, they may have been included under other artifact classes such as ground stones, hammerstones, and abraders in the field inventory. The combination of battered edges and ground faces prompted Marcia Truell in 1976 to describe the tools as hammerstone/abraders, a term that was retained for subsequent years of excavation in Chaco Canyon. Hammerstones, tools that overlapped hammerstone/abraders in function, collected from Pueblo Alto after 1976 also failed to achieve complete analytical scrutiny, although a preliminary report about those collected previously was made (Wills 1977).

Hammerstone/abraders, in contrast to hammerstones, were almost always made of sandstone and exhibited facets formed from extensive grinding, as well as being battered. Hammerstone/abraders also occurred in contexts where hammerstones rarely occurred and vice versa (Table 4.4), and these different contexts offer the best clues for explaining the probable use of both tool types. The visual dichotomy between context and material type is also statistically significant (Table 4.5), and greatly strengthens inferences regarding their different functions.

The majority of hammerstone/abraders at Pueblo Alto were recovered from just two kinds of deposits: wall fall and construction debris. Hammerstones were rarely found in these latter deposits that occurred at the bases of the primary walls where presumably the construction litter had accumulated while masons worked.

A large quantity of hammerstone/abraders, including hafted ones (discussed separately, above), were also recovered from the voluminous unit of Layer 3 construction debris (see Volume II, Figure 8.3 and Plate 8.1) forming the initial mounding of the Trash Mound. These were associated with a few hard sandstone cores from which spalls had been struck off for chinking. One such core (Plate 4.5B) weighed 3.7 kg and measured 17 by 14 by 13 cm. Another large lot of hammerstone/abraders was recovered from the area formed by a jog, which we termed the blockhouse, in Major Wall 1 (Plate 4.8). Again, the context suggests that the tools were discarded during wall construction. More were found scattered over the parking lot, which must be attributed to construction of the small ruin found there.

The Analysis

Strategy. Cluster analysis was used to provide subgroupings of the hammerstone/abraders by shape. This procedure groups entities on the basis of similarity, although there are a wide array of cluster analyses and similar programs that give different, often conflicting, results for the same data (see Aldenderfer and Blashfield 1984). The strength and

Table 4.4. Proveniences at Pueblo Alto with large assemblages of hammerstones and hammerstone/abraders, by material.

	MATERIAL						
Provenience	Sandstone	2200-2202	1109-1110	1112-1113	4000s	Other	Total
Excavation:							
Room 103, Fl. 3	0	1	7	0	0	0	8
Room 103, Fl. 4	9	1	2	3	2	1	18
Room 110, Fl. 1 (top)	0	1	7	7	4	7	26
Room 112, Fl. 3	12	0	0	0	0	0	12
Room 139, Floor 2	11	0	0	1	1	0	13
Room 142/146, WT1-WT2	32	0	0	0	0	0	32
Room 229, Fl. 2	16	0	0	0	2	0	18
PF 1, Room 3, Layer 2	8	0	0	1	0	0	9
Wall Clearing and Testing:							
All wall clearing	148	3	99	6	25	9	290
Other Structure 4	1	2	47	2	0	1	53
Other Structure 6	6	2	12	1	7	2	30
Major Wall 1, blockhouse	45	0	0	0	0	0	45
Parking Lot Ruin, surface	44	0	0	0	1	0	45
Plaza 1, Grid 159, PO fill	1	0	14	0	1	4	20
Kiva 8, trash fill	9	0	0	0	0	0	9
Kiva 10, trash fill	4	1	12	6	6	12	41
Kiva 16, trash fill	4	3	25	2	1	14	49
Trash Mound:							
Layer 3 (constr. debris)	142	0	1	0	13	0	156
All Layers except Layer 3	63	11	88	62	44	65	333

Table 4.5. Chi-square analyses of hammerstones and hammerstone/abraders by context and material.[a]

Context	Material			Totals
	Sandstone	Quartzite	Other	
CONST. DEBRIS - OTHER:				
Construction debris	311 (150.2)	19 (30.3)	8 (157.6)	338
Other[b]	96 (256.8)	63 (51.7)	419 (269.4)	578
Totals	407	82	427	916

$X^2 = 504.5$
df = 2 expected cell frequency <5 = 0
p = 0.00000

Context	Sandstone	Quartzite	Other	Totals
ENTIRE SITE:				
Construction debris	311 (155.5)	19 (30.0)	8 (152.5)	338
Other	96 (266.0)	63 (51.3)	419 (260.7)	578
Wall clearing	148 (133.5)	25 (25.7)	117 (130.8)	290
Totals	555	107	544	1,206

$X^2 = 506.7$
df = 4 expected cell frequency <5 = 0
p = 0.00000

Context	Sandstone	Quartzite	Other	Totals
ENTIRE TRASH MOUND:				
Trash Mound, Layer 3	142 (65.4)	13 (18.2)	1 (72.4)	156
Trash Mound, except Layer 3	63 (139.6)	44 (38.8)	226 (154.6)	333
Totals	205	57	227	489

$X^2 = 237.4$
df = 2 expected cell frequency <5 = 0
p = 0.00000

[a]Expected values in parentheses.
[b]From Table 4.3 but "all wall clearing" not included.

weakness of this technique lies in its simplicity, unsupported by an extensive body of statistical reasoning. Results must always be treated with caution and viewed solely as a preliminary exploratory technique needing confirmation. We have favored the use of CLUSTER (average linkage method) in the SAS program to reduce the variation among the attributes, with the cubic clustering criterion (CCC) as the basis for determining the number of meaningful clusters generated by the results (see SAS Institute 1982:417-423). The CCC is only one of several methods to test the validity of clusters, and, although it has been questioned by Aldenderfer and Blashfield (1984:76), it remains fundamental to the SAS program. All tests for the analysis were run using SAS statistical programs (SAS Institute 1982:331, 425) with the assistance of computer consultant William Doleman of the Office of Contract Archeology (University of New Mexico).

In the absence of an available algorithm for clustering categorical data, an unorthodox use was made of the average linkage cluster analysis of Boolean data (presence or absence values of zero or one). Although cluster analysis techniques assume that the input variables are continuous (ratio scale measurements), it is believed that the use of Boolean variables is justified by the tendency of the average linkage method to produce clusters with equal variances (SAS Institute 1982). Boolean values represent the simplest form of integer data and, when input to an average linkage analysis, integers result in the formation of low or zero variances around the integer values (William Doleman, personal communication 1987). Thus, the Boolean cluster analysis served to sort and group hammerstone/abraders on the basis of present or absent data, but occasionally the groups assimilated dissimilar data for one or more variables when the remaining variables were identical.

Attributes. Hammerstone/abraders were first grouped on the basis of six shapes (unknown, spherical, discoid/squarish, irregular, rectangular, and irregular). Then a separate cluster analysis using Boolean variables was run on each shape group (Table 4.6). Fragments and stones with notches and picktips were excluded. The latter two categories are discussed under Hafted Hammers. Clusters of unknown-shaped tools (n = 25) are not discussed here because the shape category is not meaningful. Spherical stones (n = 22) were infrequent, with the majority (15) forming a single cluster dominated by 9 specimens from the Trash Mound construction debris (Layer 3).

In addition to shape, the variables of edge percussion, ground faces and edges, and chipped edges were compared as Boolean variables for the cluster analyses. Our only numerical variable, weight, was tested for significance against shape with the use of both parametric tests [t-test (Satterthwaite Approximation) and the analysis of variance] and the nonparametric versions of the t-test and analysis of variance (Wilcoxon and Kruskal-Wallis, respectively).

We hypothesized that shape was a direct result of use and weight attrition. With two exceptions, however, out of 24 combinations of wear and shape, weight did not prove to be correlated with shape. Therefore, weight was discarded as a variable for the cluster analyses. One of the

Table 4.6. Hammerstone/abrader summary statistics from the cluster analysis.

Cluster	Number	Mean Weight (g)	sd	CV %	Minimum-Maximum	Battered Edges (%)	Ground Faces (%)	Ground Edges (%)	Chipped Edges (%)
SPHERE (n = 22):									
1	15	259.8	110.1	42.4	95.0 - 523.7	100	100	0	0
2	3	322.0	192.0	59.6	102.0 - 455.6	100	0	33	0
3	2	275.2	93.1	33.8	209.3 - 341.0	100	100	100	0
4	1	240.2	-	-	-	0	100	100	0
5	1	286.5	-	-	-	100	0	0	100
DISC./SQUARISH (n = 315):									
1	223[a]	259.0	175.0	67.6	27.0 - 1,445.0	100	87	0	0
2	39	267.4	122.9	45.9	102.2 - 590.0	100	79	0	100
3	32	337.6	237.2	70.2	107.4 - 1,174.0	100	91	100	0
4	4[b]	194.3	56.4	29.0	129.3 - 230.5	0	50	0	100
5	14	371.1	218.7	58.9	115.5 - 761.0	0	80	0	0
6	2	152.4	9.8	6.4	145.5 - 159.3	0	100	100	0
IRREGULAR (n = 96):									
1	68[b]	304.9	240.3	78.8	67.3 - 1,743.5	100	79	0	0
2	9	486.3	313.0	64.4	258.0 - 1,162.5	100	78	100	0
3	3	696.2	81.7	11.7	630.4 - 787.7	0	100	100	100
4	9	362.5	132.9	36.7	157.0 - 541.0	100	56	0	100
5	4	306.1	375.1	122.5	80.7 - 865.5	100	75	0	0
6	3	284.2	121.2	42.7	181.7 - 418.0	0	67	100	0
RECTANGULAR (n = 65):									
1	11	320.4	173.0	54.0	101.0 - 626.3	100	0	9	0
2	46	235.7	125.1	53.1	95.0 - 581.0	100	100	30	0
3	4	601.0	393.6	65.5	250.5 - 1,099.0	0	100	0	0
4	3	191.0	68.6	35.9	147.0 - 270.0	100	33	0	100
5	1	321.0	-	-	-	0	100	100	100
WEDGE (n = 69):									
1	51[c]	277.8	126.7	45.6	120.0 - 737.5	100	84	0	0
2	9	362.4	137.5	37.9	223.7 - 669.0	100	100	100	0
3	3	241.4	71.3	29.5	195.7 - 323.6	100	0	100	0
4	3	199.5	61.4	30.8	130.0 - 246.5	100	67	0	100
5	2	403.6	131.6	32.6	310.5 - 496.6	0	50	0	0
6	1	216.0	-	-	-	100	0	100	100
UNKNOWN	25					64	52	4	0
Total	592					93	78	16	11
Total[d]	552	290.5	191.6	66.0	27.0 - 1,743.5				

[a]Numeric statistics computed for 220 specimens.
[b]Numeric statistics computed for one specimen less than listed.
[c]Numeric statistics computed for 49 specimens.
[d]Totals without fragments.

two exceptions revealed a significant correlation between weight and irregularly shaped stones with ground edges. Those with ground edges tended to be heavier than those without, the opposite of what one might expect if wear reduces the weight of a tool. The other exception showed a correlation between discoid/squarish stones with ground faces and weight. Those with ground faces, logically, were significantly lighter than those with unaltered faces.

Categorical attributes dominated the analysis, but a mean weight was calculated for the tools in each shape cluster after the clusters were formed (Table 4.6). Note that the amount of weight variation [listed as the coefficient of variation (CV)] in each cluster is often high, confirming the expectations that weight as an attribute would not have been highly reliable as an attribute in the clusters formed. In theory a large CV is grounds for rejecting the reliability of an attribute for classification (e.g., Thomas 1976:84). Nevertheless, an attribute can be considered useful or "clustered" (i.e., exhibits central tendency) when the CVs for individual clusters fall below about 40 percent, provided that the sample size is greater than about 10 (William Doleman, personal communication 1987).

Although the dimensions of each stone were recorded, erroneously these had not been transferred to computer tapes, and time did not permit their reintroduction to the analysis. A sample (n = 127) revealed them to average 8.1 by 6.5 by 3.0 cm in size. Those from the largest assemblage at the site, Layer 3 in the Trash Mound, were slightly smaller and more uniform in size (7.7 by 6.2 by 2.8 cm) when based on a sample of 63 specimens.

Results (Table 4.7)

Most of the hammerstone/abraders were discoid/squarish stones (n = 315), with most (71 percent) forming Cluster 1. Again, Layer 3 in the Trash Mound dominates the largest cluster, although specimens from all excavated proveniences with hammerstone/abraders were represented. A significant departure from relative representativeness occurs in Clusters 2 (n = 39) and 3 (n = 32) between the tools from Room 112 and Room 229 adjacent to it. Most of the Room 112 tools were found in Cluster 2 but none were found in Cluster 3, whereas the Room 229 tools were almost absent in Cluster 2 and abundant in Cluster 3. In addition, the omnipresent Layer 3 (Trash Mound) tools dominated Cluster 2, but only one was placed in Cluster 3.

Differences between the first three clusters of discoid/squarish shape lie in the location and type of use wear. Stones in Cluster 1 revealed no altered edges, whereas all the Cluster 2 stones had chipped edges, and Cluster 3 stones had only ground edges. Mean weight, although not an influencing variable in the analysis, was similar in the first two clusters but was much heavier by about 25 percent (70 g) in Cluster 3. At least for the discoid/squarish stones recovered from Rooms 112 and 229, the differences may be related to different periods of construction sug-

Table 4.7. Distribution of whole hammerstone/abraders by shape and cluster for selected proveniences.

	PROVENIENCE																			
SHAPE	Rm 103 Fl. 4		Rm 112 Ly. 7		Rm 139 Fl. 2		Rm. 142/ Rm. 146 WT1-WT2		Rm 229 Ly. 7		PF 1, Rm. 3 Ly. 2		MW 1		Pkg. Lot		TM Ly. 3		TM other	
(Cluster)	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
SPHERE																				
1									2	13							9	6	3	8
2																	2	1		
3																				
4																				
5																				
DISC./SQ.																				
1	5	56	6	50	6	55	13	41	3	19	3	38	17	38	23	56	51	36	15	38
2							1	3	2	13			3	7	2	5	14	10		
3					2	18	1	3	5	31							2	1	3	8
4	1	11															4	3		
5																	2	1	1	3
6																				
IRREG.																				
1					2	18	12	38	3	19	2	25	9	22	3	7	10	7	2	5
2							1	3					1	2					1	3
3									1	6			1	2						
4													2	4			4	3		
5																	2	1		
6																			1	3
RECT.																				
1							1	3									5	3	1	3
2	2	22									3	38	4	9	5	12	10	7	2	5
3																	1	1		
4																	2	1		
5																				
WEDGE																				
1	1	11	1	8	1	9	3	9					5	11	5	12	15	10	5	13
2													2	4			1	1	3	8
3													1	2						
4																	2	1		
5																				
6																				
UNKNOWN																				
All			5	42											3	7	7	5	3	8
Totals	9	100	12	100	11	100	32	100	16	101	8	101	45	101	41	99	143	98	40	105

gested by the wall abutments. Presumably, the differences mark a change in stone-shaping techniques, perhaps because of the use by different personnel or a change in masonry veneer style requiring different stone veneer shapes.

Finally, Cluster 5 of the discoid/squarish forms contained only stones with ground faces and no altered edges. Clusters 4 and 6 had only 6 stones between them and were placed in separate clusters because one type of edge modification was present. The mean weight, not an influential factor, was the lightest for these stones. Although edge percussion was common in the six clusters, none occurred without some type of grinding, thereby excluding them from strict designation as hammerstones.

Stones with irregular shapes (n = 96), basically unmodified by use, formed 6 clusters. The majority (72 percent) formed Cluster 1. Despite the overwhelming prominence of the Trash Mound tools in the overall analysis, irregular shapes were dominated by the tools from Major Wall 1 at the blockhouse (9) and the Central Roomblock rooms (15) in Cluster 1, but only 10 came from Layer 3 of the Trash Mound. Poor representation by Layer 3 tools suggests that they suffered more extensive wear, altering their natural shapes, or that irregular shapes were not as highly favored as other forms for tools. Irregular stones tended to be much heavier tools than their counterparts.

Wedge-shaped forms (n = 69) are similar to the crude chopping implements discussed elsewhere in this chapter, but they generally lack the sharp edges needed for cutting, and they were not hafted. Perhaps they were originally choppers reused as hammerstone/abraders, although we have no comparative data on which to base a less subjective impression. The common association of these wedge-shaped tools with construction debris suggests their use during construction activities. The largest cluster, forming 74 percent of the group, contained a large minority (29 percent of the 51 stones) of those from Layer 3 in the Trash Mound, but the Parking Lot Ruin and Major Wall 1 were also represented (10 percent each).

Finally, rectangular tools (n = 65) were represented by the same proveniences commonly found throughout the other cluster forms. The largest cluster, forming 74 percent of the group, is marked by a third of the tools with ground edges--the only <u>large</u> cluster of any form with this attribute present in conjunction with ground faces and battered edges. The form, of course, lends itself more readily to multiple-edge use. Only the deposits of construction debris in Room 229 failed to yield these stones, although they commonly comprised about 10 percent of other assemblages.

Summary and Conclusions

In summary, despite the variety of forms, hammerstone/abraders comprise a homogeneous type of tool that is separable from other tools by its size and characteristic wear. The context in which they were found is strong evidence that they were part of a tool kit in use by wall masons

during the initial greathouse construction in the early A.D. 1000s but not in later periods.

Although similar siliceous hammers dominate stone-working afterwards, apparently the local sandstone was preferable for the task of construction. The material for non-sandstone hammerstones was locally available, but it was rarely used during construction. Perhaps labor was not available to procure the multitude of stones for this purpose because so many were needed. If local sources of harder stone had been widely utilized for masons' tools, this use would have depleted the stocks of hammers needed for other uses (e.g., sharpening grinding tools). The change in material preference through time for hammerstones suggests that resource depletion may have been a problem (Wills 1977). On the other hand, finishing building blocks with sandstone abraders was probably more efficient than using harder materials. Great emphasis was placed on grinding and smoothing masonry blocks in the early A.D. 1100s, but tools used for this purpose have not been identified, and we found none in contexts suggesting such use.

The numerous tools recovered from the postoccupational room fill were associated primarily with wall rubble. It is presumed that those in the fill came from the collapsing walls where they had been placed during construction, rather than tools left during the site abandonment.

The overall impression of hammerstone/abraders is one of uniformity in form, wear, and context. Differences observed among various proveniences could reflect different motor habits of the users and the style of masonry veneer being fashioned. That is, the deposits offer the potential for assessing the organization and other behavioral aspects of construction on both the inter- and intrasite level, particularly in contrast to small-house construction. It is likely, however, that many of the differences are related to sample size variation. Only Major Wall 1 distinctly differs in masonry style from other walls associated with the tools, yet its overall distribution of tools by shape and wear is no different from others. The stone tools from Major Wall 1 are much heavier than many of their counterparts from earlier contexts (Figure 4.1; Table 4.8), perhaps, in part, because of differences in the materials used and the method of veneer surface preparation. There may be a correlation between time and tool weight, but it is not clear from the present analysis. Except for Room 229, however, hammerstone/abraders from early construction contexts exhibited similar mean weights. Examination of the relationship among masonry styles, stages of construction, and hammerstone/abraders should be more critically examined in future greathouse work.

Manos

All the manos recovered at Pueblo Alto were analyzed (Cameron 1977, 1985). Using some of Cameron's mano attributes, an overview of the Pueblo Alto manos is presented here with an examination of specific contexts and proveniences to discern spatial and temporal patterns. In addition, data concerning mano and related tool assemblages as clues to their use was

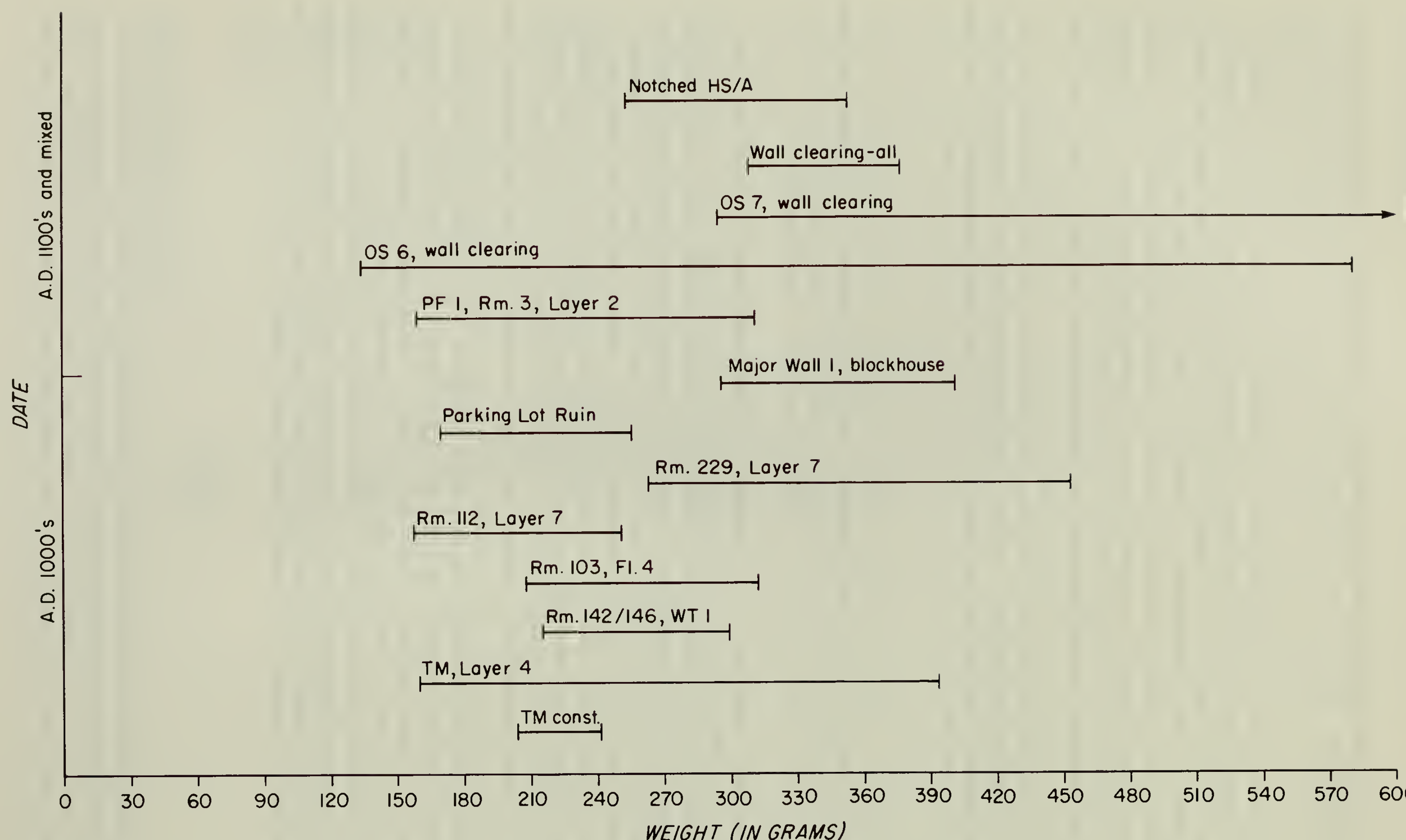


Figure 4.1. Mean weight spans of hammerstone/abraders from selected proveniences calculated at the 95 percent confidence interval.

Table 4.8. Hammerstone/abrader weight (grams) statistics for selected proveniences.

Provenience	Number Whole	Mean	sd	95% Conf. Interval	CV %	Minimum-Maximum
Room 103, Floor 4	9	259.9	79.8	±52.1	30.7	139.9 - 390.9
Room 112, Layer 7	7	204.0	62.8	±46.5	30.8	145.5 - 336.2
Room 142/146, WT 1	35	257.3	126.5	±41.9	49.2	67.3 - 644.7
Room 229, Layer 7	14	357.5	182.7	±95.7	51.1	178.6 - 665.7
PF 1, Room 3, Layer 2	8	235.0	111.0	±76.9	47.2	110.7 - 365.8
Trash Mound, Layer 4	25	277.3	295.0	±115.6	106.4	44.0 - 1,493.2
Trash Mound, const. debris	131	223.0	108.6	±18.6	48.7	72.0 - 607.0
Parking Lot Ruin surface	38	211.7	135.4	±43.1	63.9	90.0 - 745.0
Major Wall 1, blockhouse	42	348.1	174.1	±52.7	50.0	95.2 - 789.2
Wall clearing: All structures	146	341.2	209.8	±34.0	61.5	71.7 - 1,743.5
OS 6, wall clearing	6	356.6	278.4	±222.8	78.1	71.7 - 743.5
OS 7, wall clearing	6	501.0	262.8	±210.3	52.5	201.0 - 865.5

solicited. Although it was not possible to examine all the mano groups recovered from Pueblo Alto, those associated with mealing bins in Rooms 103 and 110 (Plates 4.10-4.13) were used in this study to provide information about artifact assemblages associated with mealing activities (see A Mealing Bin Work Area below).

General Information

Cameron's study revealed that all 378 manos from Pueblo Alto were for two-hand use in trough metates and that few (n = 30, 8 percent) revealed multifacial use, although secondary grinding was common. McKenna (1984: 261) attributes the slight grinding on the side(s) opposite the primary grinding surface to occasional use or an effort to smooth the tool for hand comfort. Most of the manos recovered were fragments (75 percent). Although a sizable number were whole (96), many of these were extensively worn (58 percent), and some exhibited other tool use (11 percent). The average dimensions of the whole Alto manos are 19 by 11 by 3 cm (Table 4.9). Sandstone, apparently locally derived, was the only material used in their manufacture except for a solitary quartzite specimen. Although one mano made of vesicular basalt was recovered from Pueblo Bonito and is now curated at the American Museum of Natural History, none was recovered at Alto. The preferred material was a locally abundant, fine-grained sandstone (90 percent). Many manos revealed no pecking marks (26 percent) and generally, "secondary" use by polishing was much higher (at 69 percent) than the small-site sample (see below).

Smooth, polished, fine-grained stones (16 percent of the mano total) provoked analytical controversy over their classification as manos rather than as abraders. Another 54 artifacts, similar to the smooth, polished manos were analyzed as "mano-like" abraders (e.g., Plate 4.12A) by Akins (this volume). These compared in every way with manos except for their degree of coarseness and the direction of their striations (lengthwise). In addition, another 126 that had formerly been manos were analyzed only as abraders (e.g., Plate 4.13A and F). These 180 specimens were not recorded under the mano inventory and could not be analyzed here, although all probably could be classified as manos. Finally, few of the 378 manos analyzed here exhibited secondary battering (3), chipping (5), or both (3), although others may have only been classified and analyzed for the secondary tool form. Fifteen manos revealed pigment and may have been used during the grinding of ores for paint or as paint palettes. Six percent of the Pueblo Alto manos revealed finger grips, a percentage that is approximately similar to that of other sites in Chaco Canyon, except at the small house of 29SJ 1360 (McKenna 1984:257). The majority of these Pueblo Alto manos (15 of 22) had only a single indentation, whereas the remainder revealed two, except for two manos from Room 110 that had grooves for the fingers. The majority of manos with finger grips came from the West Wing, including five from Room 103. Half of those with grips were triangular in cross section (Type 3 manos, see below).

Because of the motor action involved in grinding, shape is an important variable for mano analysis. Generally, the manos began as a rectan-

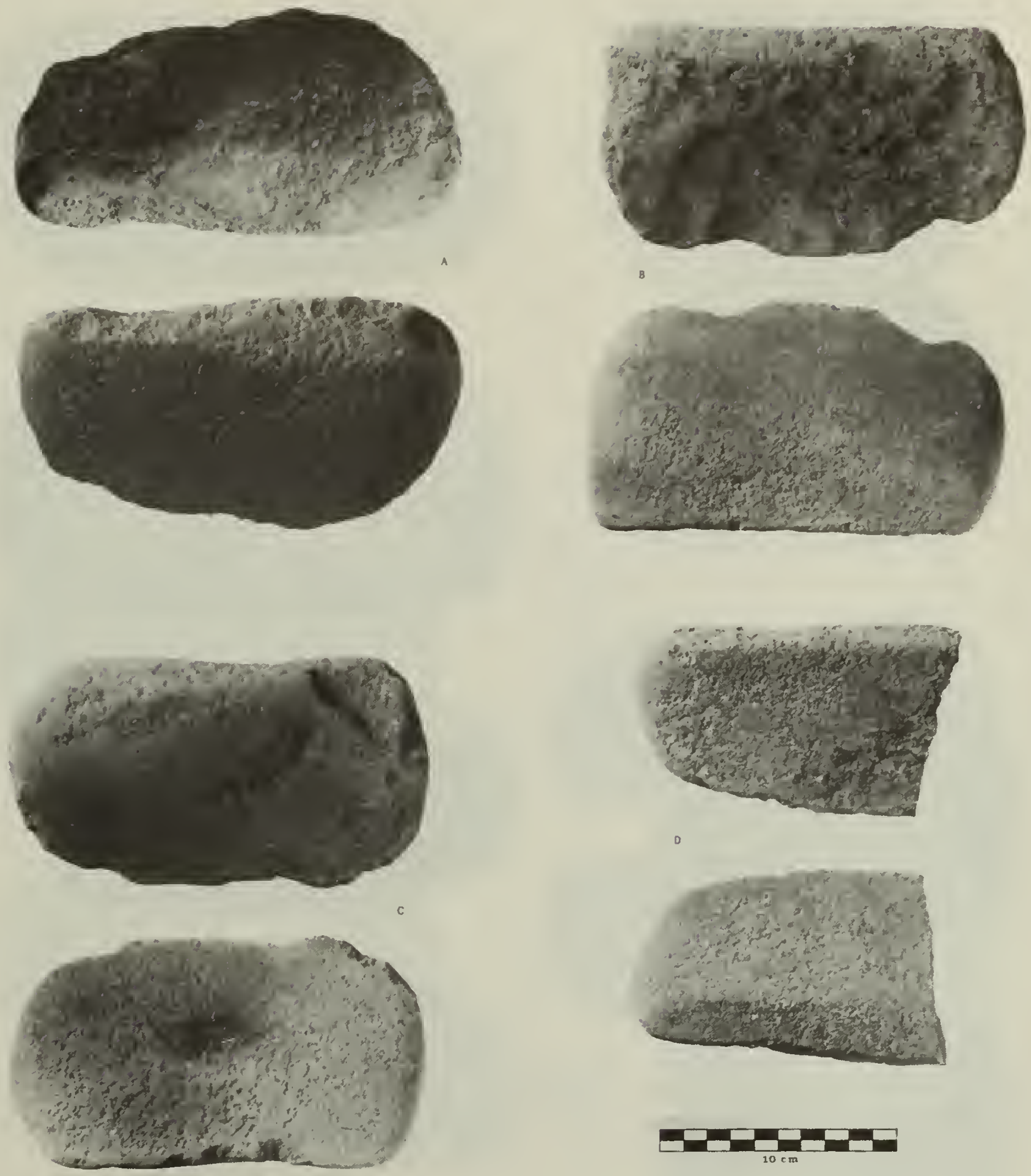


Plate 4.10. Manos from Mealing Bins 2 and 5 in Room 110, Floor 1. A. MB 2, Mano #2 (NPS#25511-25512). B. MB 2, Mano #4 (NPS#25509-25510). C. MB 2, Mano #5 (NPS#25507-25508). D. MB 5, Mano #1 (NPS#25515-25516).

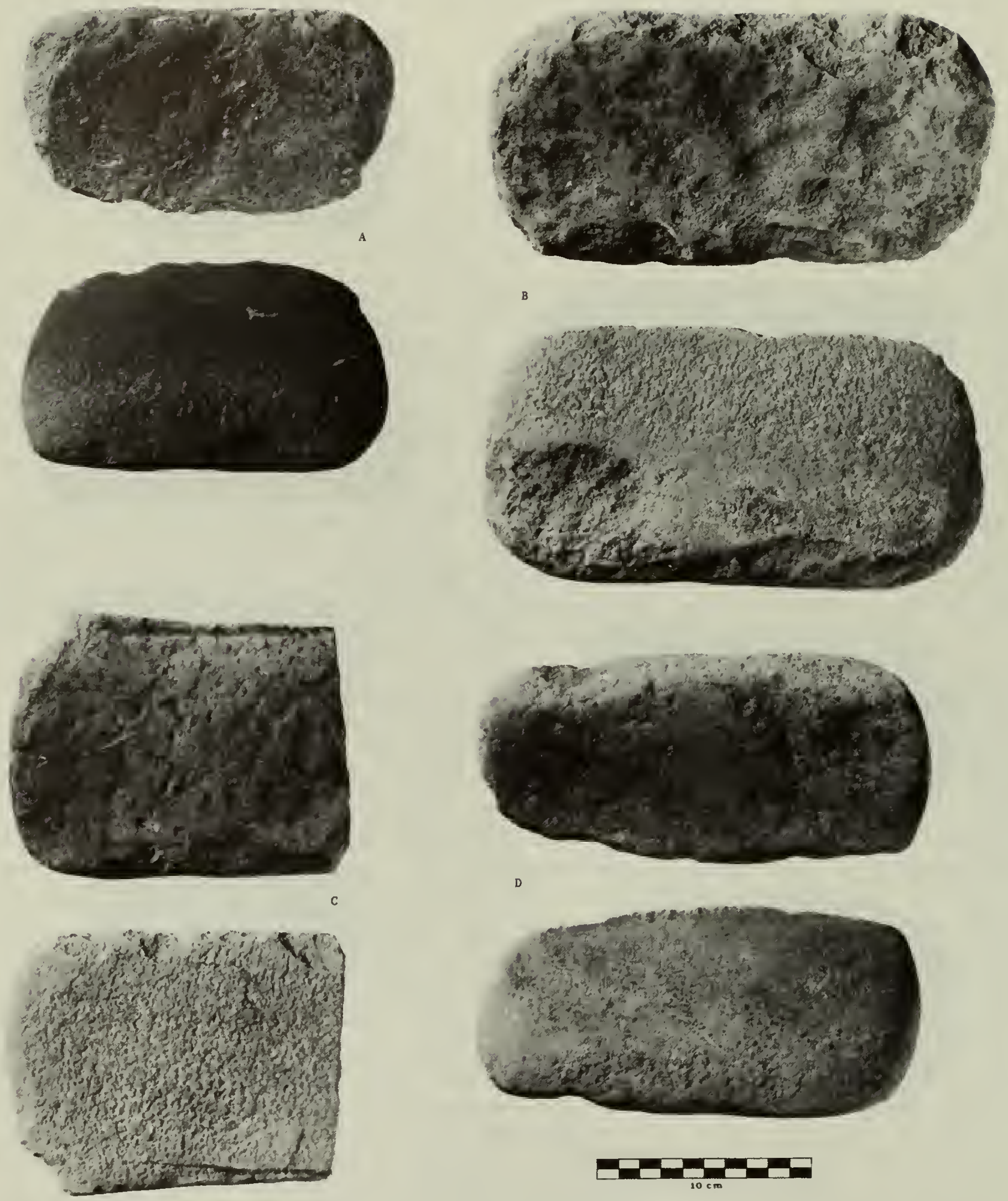


Plate 4.11. Manos from Mealing Bins 3 and 5 in Room 110, Floor 1. A. MB 3, Mano #1 (NPS#25499-25500). B. MB 3, Mano #2 (NPS#25501-25502). C. MB 3, Mano #5 (NPS#25503-25504). D. MB 5, Mano #2 (NPS#25513-25514).

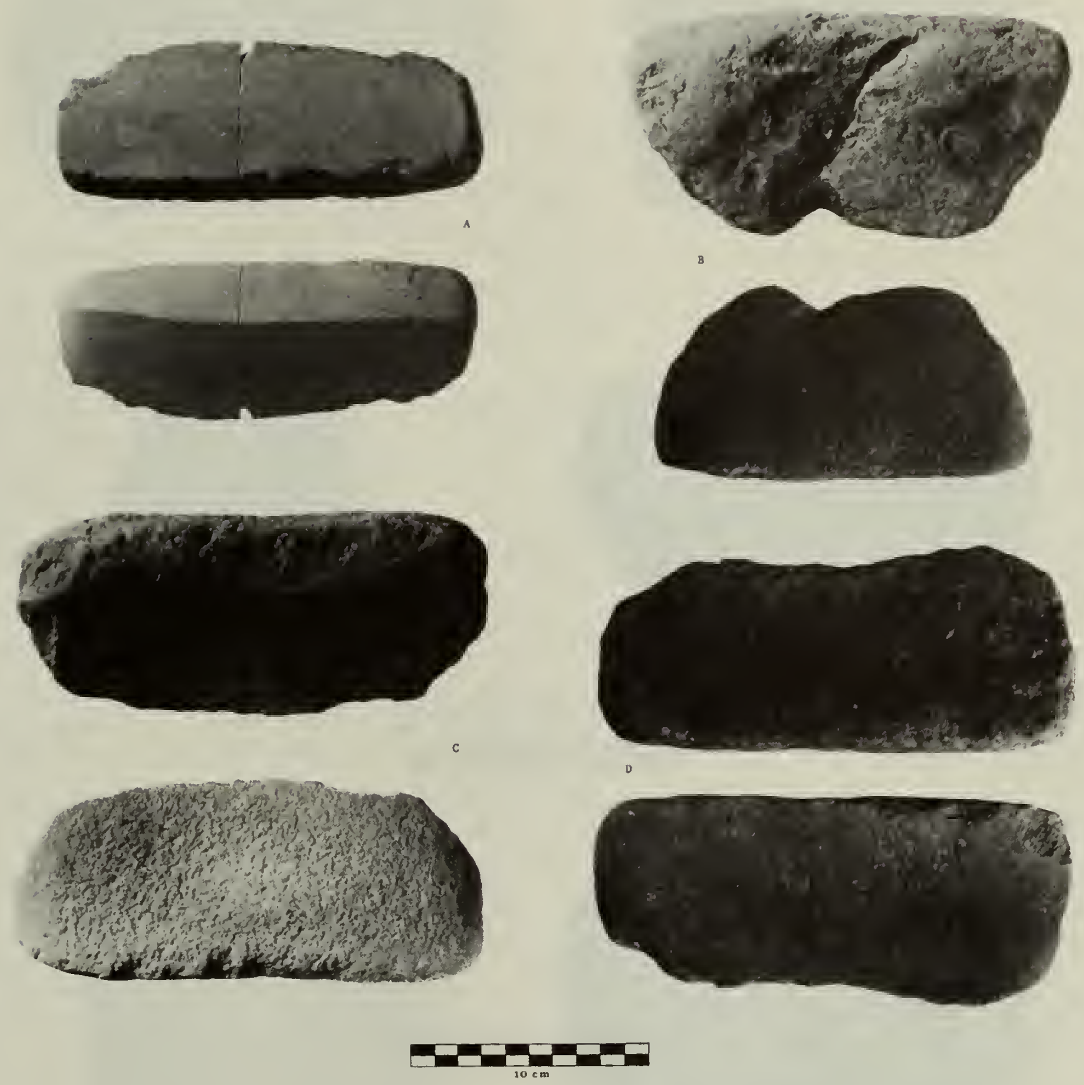


Plate 4.12. Manos from Mealing Bin 6 and Niche 9 in Room 110, Floor 1. A. MB 6, Mano #1, a "mano-like abrader" (NPS#25519-25520). B. MB 6, Mano #2 (NPS#25505-25506). C. N 9, Mano #1 (NPS# 25496-25497). D. N 9, Mano #2 (NPS#25497-25498).

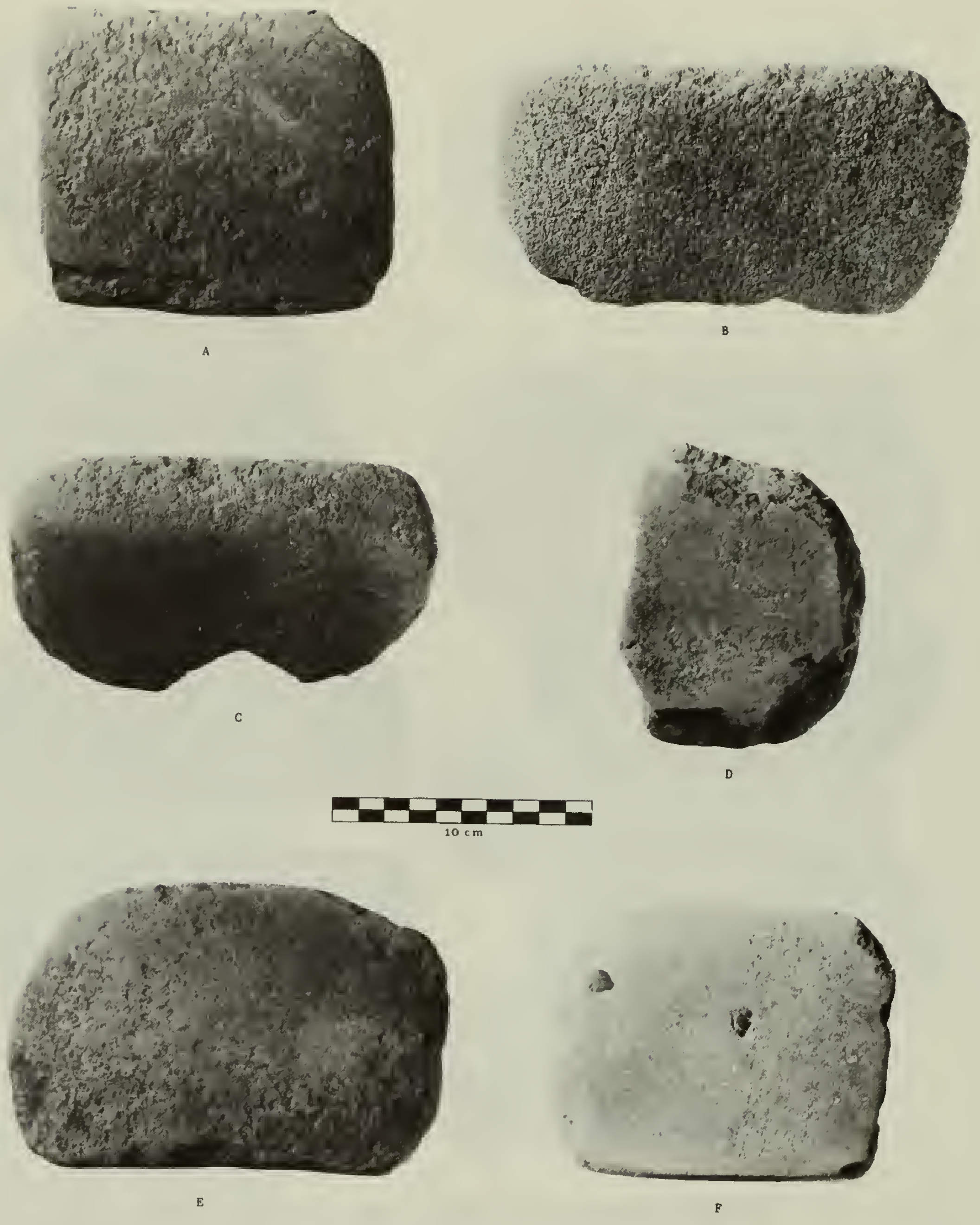


Plate 4.13. Manos from Mealing Bin 4 and on the floor next to the mealing bins in Room 110, Floor 1. FA = floor artifact. A. MB 4, Mano #1 (NPS#25517). B. FA 10 (NPS#25488). C. FA 12 (NPS# 25489). D. FA 14 (NPS#25522). E. FA 15 (NPS#25491). F. FA 17 (NPS#25528).

Table 4.9. Basic attributes of whole Pueblo Alto manos.

variable	Number	Mean	sd	CV %	Range
Weight	96	1,075.2 g	460.0	42.8	537.0 - 2,610.0
Length	96	19.3 cm	2.9	14.8	12.1 - 27.5
Width	96	10.5 cm	1.4	13.5	7.0 - 17.5
Thickness	96	2.9 cm	0.9	29.6	0.6 - 5.8
Grind. surface (primary)	96	171.0 cm^2	37.4	21.9	90.0 - 262.0
Grind. surface (secondary)	9	149.0 cm^2	34.9	23.4	96.0 - 198.0

Table 4.10. Mano cross-section types. Variability between small sites and Pueblo Alto.

Site[b,c]	Mano cross-section type[a] 1	2	3	4	5	6	7	Total	Unknown
29SJ 627	61	24	141	14	4	0	88	332	22
%	18	7	43	4	1	-	27	100	-
29SJ 629	35	16	37	18	4	1	44	155	22
%	23	10	24	12	3	1	28	101	-
29SJ 1360	20	1	59	2	1	1	8	92	3
%	22	1	64	2	1	1	9	100	-
Pueblo Alto	39	72	126	38	1	0	61	337	41
%	12	21	37	11	T[d]	-	18	99	-

[a]Types: 1 = rectangular, 2 = trapezoid, 3 = wedge, 4 = triangular, 5 = other, 6 = bi-triangular (square), 7 = tabular (discoid). After Cameron 1985.
[b]Non-Pueblo Alto sites from Cameron 1977.
[c]Sample size of site total (627 = 56%, 629 = 100%, 1360 = 41%, Alto = 100%).
[d]T = trace (less than 0.5%).

gular block that was slowly modified by use to some other form. The type of platform on which the mano was used (i.e., the metate) can be determined by the wear of the mano. Thus, shape can be informative of motor habits and, perhaps, provide clues as to temporal and spatial differences as well as possible changes in food preparation.

Based on cross section, Cameron (1977, 1985) defined a number of different mano types (the stylized forms are illustrated in Table 4.10). These followed previous reconstructions of mano-shape evolution determined by increased wear and varying motor habits related to grinding (e.g., Bartlett 1933:Figure 7; Reinhart 1965). In cross section, the Pueblo Alto manos were dissimilar from the small-site samples (at 29SJ 627, 29SJ 629, and 29SJ 1360) that were nearly contemporary with the early beginnings at Alto in the early A.D. 1000s (Table 4.10). Large, blocky, rectangular (Type 1) manos, which Cameron attributes to new, relatively unused manos, were twice as common at the small sites than at Pueblo Alto (10 percent).

The paucity of Type 1 manos at Pueblo Alto might be economically significant (e.g., few were made at Pueblo Alto) or it may result simply from use of harder sandstones at Alto (see below) that allowed for longer mano use-lives. On the other hand, trapezoid or beveled (Type 2) and wedged-shaped and triangular (Types 3 and 4, respectively) manos were more common at Alto than at the small sites. Types 2-4 increase in relative frequency with greater wear, whereas the blocky Type 1 manos decrease, thereby suggesting that Types 2-4 were derived from Type 1 forms. Tabular discoid forms (Type 7), however, are similar to Type 1 forms in that they decrease proportionally with increased wear. Type 7 manos are too thin, however, to have been worn into new shapes. Thus, new manos were comprised of two forms, blocky and tabular. Type 7 manos retained the same shape throughout their use, but Type 1 manos were worn to form Types 2-4. Generally, the proportion of cross-section types changed little through time at Alto. Trapezoid types were slightly more popular in the last half of the A.D. 1000s than other periods, whereas triangular ones (Types 3 and 4) were slightly more so in the early A.D. 1100s.

Material hardness of the Chaco Canyon manos also differed among sites. Again, Pueblo Alto differs from the small sites except for 29SJ 629, with both sites exhibiting higher use (by twice or more) of very hard sandstone (24 and 22 percent, respectively). Although it is unclear why this difference exists, manos of hard sandstone would have lasted longer than those made of softed materials.

Historically, gradations in mano and metate hardness and material reflected different stages of the grinding process (e.g., Bartlett 1933; Roberts 1958). These stages usually involved a trio of metates of different coarseness on which meal was ground. Fortuitously, perhaps, metate bins ofter occur in sets of three, particularly at Pueblo Alto, which might indicate the very early use of grinding sets graded by coarseness. The metates examined at Alto, however, do not reveal this distinction, nor do the manos. The lack of variation in local materials for manufacturing manos and metates may have prevented the contrasts in surface coarseness seen in other areas. There was a difference between sharpened and unshar-

pened (e.g., roughened and unroughened) manos, which suggests that the degree of sharpening may have served to vary the grinding surface coarseness.

Weight may be an important mano attribute, although industrial grinding experiments suggest otherwise (see Hard 1986:108; Lancaster 1983:75-86). Hard (1986:108-111) suggests that grinding area, not weight, was critical in decreasing the amount of time required to process meal. Time, not energy expenditure, according to Hard was the important factor in an increasingly complex society.

When the weight of the 96 whole manos was examined, there was clear bimodality (Figure 4.2). Mano frequency declined sharply at about 1,000 g. The two groups formed by the split in weight distribution were light and heavy mano groups, weighing 750 g (n = 52) and 1,460 g (n = 44), respectively (Table 4.11). A small number of manos weighed more than 1,550 g (n = 10) and may have formed a very heavy, third group (mean = 2,130 g). When specific clusters of manos were examined, light and heavy manos often co-occurred. When the two groups were compared, a t-test of the differences between the sample means for the grinding surface areas of the two types was barely significant at the .05 level, suggesting that the two types might have been used in different ways. By Lancaster's (1983: 87) criterion, Type 7 manos were less efficient than the Type 1 manos. Given that both types were often found together in the same bins, however, the difference in grinding areas, if any, may be attributed to different uses (e.g., different stages in the food reduction process, different materials being processed, or use on different types of metates).

Distribution in Mealing Bins

The pairings of both mano types in the Room 110 mealing bins suggest preference for a set of 1 or 2 heavy and 1 or 2 light manos per individual metate. In all cases, manos exceeding 1,000 g (e.g., heavy manos) revealed only light to moderate use, indicating that they were new (Table 4.12; see also Table 4.13)). Logically, the Types 1 and 7 light-weight manos were judged to be typically heavily worn. Otherwise, Types 1 and 7 averaged over 1,000 g and generally revealed light or moderate use. A slight majority of the mano fragments in the Room 110 mealing bins exhibited only moderate wear; more characteristically, the remainder revealed heavy wear. Despite their thinness, Type 7 manos were not broken more often than other types. In general, heavy manos were seldom broken (9 of 53, 17 percent), whereas manos weighing less than 1,000 gm were usually broken (273 of 325, 84 percent). Probably lighter (i.e., thinner) manos were more fragile and had been resharpened over their lifetime more than heavier and Type 7 manos and were, thus, more likely to be broken during sharpening.

Overall, the frequency of manos in and around the Room 110 mealing bins averages 3.3 whole manos per bin (20 manos for 6 bins), or 5.3 per bin for all manos, including the broken ones. In a rare comparable situation at a small-house site, an outdoor grinding area behind an L-shaped

Figure 4.2. Weight distribution for the 96 whole manos from Pueblo Alto.

Table 4.11. Summary statistics for whole manos from selected Pueblo Alto proveniences.

Provenience	No.	Mean	sd	CV %	Range
Room 103, Floor 3[a]					
weight (g)	4	1,389.9	177.3	12.8	1,183.0 - 1,581.5
length (cm)	4	18.9	1.7	9.0	16.5 - 20.5
width (cm)	4	9.9	1.0	10.4	8.7 - 11.0
thickness (cm)	4	4.2	0.5	12.1	3.5 - 4.7
grind. area A (cm^2)	4	168.5	21.5	12.8	147.0 - 187.0
grind. area B (cm^2)	1	159.0			
Room 103, Floor 3[b]					
weight (g)	2	764.0	148.5	1.9	753.5 - 774.5
length (cm)	2	18.4	2.3	12.6	16.8 - 20.1
width (cm)	2	9.4	1.2	12.9	8.5 - 10.2
thickness (cm)	2	3.0	0.6	18.9	2.6 3.4
grind. area A (cm^2)	2	152.5	9.2	6.0	146.0 - 159.0
Room 110[a]					
weight (g)	10	1,658.8	502.5	30.3	1,143.5 - 2,490.0
length (cm)	10	21.4	2.2	10.3	18.0 - 24.0
width (cm)	10	11.8	2.3	19.5	8.7 - 17.5
thickness (cm)	10	3.1	1.2	39.0	1.4 - 5.8
grind. area A (cm^2)	10	201.5	40.9	20.3	142.0 262.0
Room 110[b]					
weight (g)	16	735.1	125.0	17.0	540.5 - 972.0
length (cm)	16	18.7	2.0	10.7	15.5 - 23.0
width (cm)	16	9.8	1.0	10.0	7.0 - 11.5
thickness (cm)	16	2.5	0.5	21.0	1.5 3.5
grind. area A (cm^2)	16	158.3	24.3	15.3	137.0 - 227.0
Room 112[a]					
weight (g)	3	1,152.8	481.0	4.2	1,117.0 - 1,207.5
length (cm)	3	20.0	1.3	6.6	18.5 - 21.0
width (cm)	3	10.8	0.4	3.3	10.5 11.2
thickness (cm)	3	3.1	0.6	18.1	2.5 - 3.6
grind. area A (cm^2)	3	196.7	12.7	6.5	182.0 - 204.0
Room 143[a]					
weight (g)	4	1,511.9	746.4	49.4	1,027.5 - 2,610.0
length (cm)	4	22.7	2.4	10.6	20.2 - 26.0
width (cm)	4	11.0	1.3	11.5	9.3 - 12.0
thickness (cm)	4	2.7	0.8	29.6	1.9 - 3.8
grind. area A (cm^2)	4	218.3	23.6	10.8	188.0 238.0
Room 143[b]					
weight (g)	2	792.8	159.5	20.1	680.0 - 905.5
length (gm)	2	17.5	5.6	32.0	13.5 - 21.4
width (cm)	2	10.0	1.4	14.1	9.0 - 11.0
thickness (cm)	2	2.8	1.5	54.0	1.7 - 3.8
grind. area A (cm^2)	2	155.5	17.7	11.4	143.0 - 168.0

[a]Manos weighing more than 1,000 g.
[b]Manos weighing less than 1,000 g.

Table 4.11. (concluded).

Provenience	No.	Mean	sd	CV %	Range
Late arc structures[a]					
weight (g)	4	1,491.6	303.9	20.4	1,243.0 - 1,905.0
length (cm)	4	21.0	2.8	13.2	17.0 - 23.1
width (cm)	4	11.1	1.5	13.3	8.9 - 12.0
thickness (cm)	4	3.9	0.8	19.0	2.8 - 4.4
grind. area A (cm^2)	4	187.3	24.5	13.1	158.0 - 209.0
Late arc structures[b]					
weight (g)	11	758.8	146.5	19.3	554.5 - 952.0
length (cm)	11	17.5	2.5	14.4	12.9 - 21.3
width (cm)	11	9.8	1.3	13.3	7.7 - 12.4
thickness (cm)	11	2.8	0.4	13.3	2.1 - 3.5
grind. area A (cm^2)	11	140.5	20.7	14.7	109.0 - 182.0
grind. area B (cm^2)	11	131.0	35.4	27.0	106.0 - 156.0
All whole manos[a]					
weight (g)	44	1,456.1	417.9	28.7	1,027.5 - 2,610.0
length (cm)	44	20.9	2.6	12.2	15.0 - 27.5
width (cm)	44	11.2	1.4	12.9	8.7 - 17.5
thickness (cm)	44	3.3	0.9	28.1	1.4 - 5.8
grind. area A (cm^2)	44	193.9	35.1	18.1	112.0 - 262.0
grind. area B (cm^2)	5	169.6	26.1	15.4	130.0 - 198.0
All whole manos[b]					
weight (g)	52	752.9	125.8	16.7	537.0 - 986.0
length (cm)	52	18.0	2.4	13.2	12.1 - 23.0
width (cm)	52	9.9	1.1	11.3	7.0 - 12.4
thickness (cm)	52	2.5	0.6	25.0	0.6 - 3.8
grind. area A (cm^2)	52	151.7	27.1	17.9	90.0 - 251.0
grind. area B (cm^2)	4	123.3	27.4	22.2	96.0 156.0
Type 1 manos					
weight (g)	15	1,777.9	541.3	30.4	920.0 - 2,610.0
length (cm)	15	19.3	2.4	12.5	15.0 - 23.1
width (cm)	15	11.1	2.3	19.5	8.7 - 17.5
thickness (cm)	15	4.0	0.8	20.0	2.6 - 5.8
grind. area A (cm^2)	15	171.7	30.2	17.6	136.0 - 234.0
grind. area B (cm^2)	15	178.5	27.6	15.4	159.0 - 198.0
Type 7 manos					
weight (g)	18	1,182.2	348.7	29.5	666.5 - 1,911.1
length (cm)	18	20.2	3.2	16.0	12.9 - 24.0
width (cm)	18	11.4	0.8	7.4	94.0 - 12.6
thickness (gm)	18	2.4	0.6	23.7	1.4 - 3.2
grind. area A (cm^2)	18	201.7	45.8	22.7	109.0 - 262.0
grind. area B (cm^2)	1	180.0	-	-	- -

[a]Manos weighing more than 1,000 g.
[b]Manos weighing less than 1,000 g.

Table 4.12. List of manos recovered from in and around the mealing bins in Room 110.[a]

Location	FS No.	Artifact Number[b]	Length (cm)	Width (cm)	Thickness (cm)	Weight (g)	Primary Grinding Area (cm^2)[c]	Amount of Wear[d]	Cross Section Type[e]
MB 1 fill	5680	-	18.2	9.2	2.1	681.5	160	3	2
MB 1 fill	5684	-	20.5	8.7	3.3	1,350.5	142	1	1
MB 1 const.	1522	-	15.7+	9.6	3.6	1,293.5+	125+	2	1
near MB 1	5431	FA 21	19.1	11.7	4.2	2,313.3	169	1	1
MB 2 fill	5434	1	9.4+	7.6	2.5	292.5+	63+	2	3
MB 2 fill	5434	3	8.8+	8.2	3.5	324.0+	62+	3	3
MB 2 floor	5435	2	19.1	9.9	3.3	877.5	137	3	3
MB 2 floor	5435	4	18.3	10.0	1.8	540.5	142	3	2
MB 2 floor	5435	5	18.2	9.9	2.2	636.0	152	3	3
MB 3 fill	5436	3	?	?	?	470.7+	66+	2	3
MB 3 fill	5436	4	14.7+	9.4	3.4	703.0+	99+	2	1
MB 3 floor	5437	1	17.6	10.1	2.2	680.5	158	3	2
MB 3 floor	5437	2	23.6	11.9	1.9	1,341.5	245	1	7
MB 3 floor	5437	5	15.5+	12.0	1.5	836.5	168	2	7
near MB 3	5427[f]	FA 17	13.5+	10.6	3.6	868. +	133+	3	2
MB 4 floor	5439[f]	1	13.6+	11.8	2.9	943.7+	141+	2	7
near MB 4	5424[i]	FA 14	9.0+	11.5	3.4	638.3+	53+	3	7
near MB 4	5425	FA 15	17.3	11.5	3.0	922.0	167	3	3
MB 5 floor	5441	1	12.8+	8.5	2.3	394.0+	93+	3	2
MB 5 floor	5441	2	18.6	9.0	2.8	644.0	141	3	2
MB 5 const.	5442	3	10.2+	11.0	2.8	481.3	98	3	3
near MB 5	5422[g]	FA 12	18.8	10.2	3.5	855.0	163	2	3
MB 6 fill	1531	-	24.0	12.0	1.4	1,157.5	262	1	7
MB 6 floor	5444[h]	1	18.1	6.8	2.1	352.0	105, 95, 75	2	2
MB 6 floor	5444	2	19.0	9.5	2.7	687.0	145	3	3
near MB 6	5416	FA 6	23.0	11.1	1.5	972.0	227	2	7
near MB 6	5418[i]	FA 8	?	?	?	?	?	?	?
near MB 6	5420	FA 10	16.7	9.2	2.4	597.7	139	3	2
near MB 6	5414-5415	FA 4 & 5	19.8	11.5	2.3	897.0	192	2	3
OP 64 floor	5742	-	22.5	12.5	2.7	1,911.1	232	1	7
N 9 floor[j]	5446[g]	1	23.3	10.0	2.7	1,147.5	205	2	3
N 9 floor[j]	5446	2	23.0	10.2	2.6	864.5	202	3	3

[a]A measurement with a + suffix denotes a fragment.

[b]Refers to room Floor Artifact number or the mano number of a set within a mealing bin. See distribution of manos and other artifacts in Figure 4.4.

[c]None but 1 exhibited a secondary grinding, although many were smoothed on top.

[d]Wear: 1 = light, 2 = moderate, 3 = heavy.

[e]Type: 1 = rectangular; 2 = trapezoid; 3 = wedge triangular, 7 = tabular.

[f]Analyzed only as a Type 10 abrader (see Akins, this volume).

[g]Exhibited finger grooves for grasping.

[h]Analyzed as a "mano-like" abrader (see Akins, this volume), with 3 grinding surfaces.

[i]Was not listed on analysts' printouts.

[j]Wall Niche 9 formerly designated Storage Cist 1.

Table 4.13. List of manos recovered from in and around the mealing bins in Room 103, Floor 3.[a]

Location	FS No.	Artifact Number[b]	Length (cm)	Width (cm)	Thickness (cm)	Weight (g)	Primary Grinding Area (cm^2)[c]	Amount of Wear[d]	Cross Section Type[e]
MB 1 fill	1293	FA 8	11.3+	8.8	2.5	429.0+	96+	3	2
MB 1 constr.	1296	FA 10	19.0	8.7	4.7	1,483.0	153	2	1
MB 2 fill	1297[f]	FA 14	10.7+	9.0	1.6	354.7+	88+	4	4
MB 2 floor	1298	FA 17	7.6+	11.2	1.4	259.4+	66+	4	4
MB 2 constr.	1299	FA 36	16.6	10.2	2.6	774.5	159	3	2
MB 3 constr.	1257	-	20.1	8.5	3.4	753.5	146	3	3
MB 3 constr.	1302[f]		20.5	10.5	3.5	1183.0	187	3	3
Hearth 1 fill	1303	FA 28	16.5	9.5	4.4	1,312.0	147	2	1
Hearth 1 fill	1303[g]	FA 29	19.5	11.0	4.3	1,581.5	187/159	2	1

[a]A measurement with a + suffix denotes a fragment.
[b]Refers to room-floor artifact number.
[c]Secondary grinding surface follows a slash.
[d]Wear: 1 = light, 2 = moderate, 3 = heavy, 4 = worn out.
[e]Type: 1 = rectangular, 2 = trapezoid, 3 = wedge triangular, 4 = triangular, 7 = tabular.
[f]Exhibited 1 indentation for a finger grip.
[g]Exhibited 2 indentations for finger grips.

wall at 29SJ 1360 (McKenna 1984:Figure 4.11) revealed 3 catchment basins and 26 manos (the majority whole) or 8.7 manos per metate. If the area was shared by the two families postulated to have occupied the adjacent pithouse (McKenna 1984:362), and each family had its own set of metates that were used with the catchment basins, then the number of manos per metate may have been half that calculated. Either way, several manos per metate (e.g., 3-7) seems typical in cases where there is good preservation of in situ artifacts (see McGimsey 1980 for multiple examples). Although Cameron (1985:20) suggests that mano use rates may have been substantially higher at the greathouses compared to the small-house sites, the calculations are saddled with too many uncertainties when comparing site population to the total number of manos found at the site. Based on a few examples of mealing bins and associated manos, mano use rates at both types of sites may have been approximately the same.

Distribution at the Site

Manos and mano fragments were scattered through the deposits at Pueblo Alto in disproportionate numbers. Few (n = 23) were recovered from wall clearing of the primary roomblocks, and these were distributed about equally among the East Wing, West Wing, and the Central Roomblock. Most of these were fragments (18, 78 percent). The enclosing plaza arc of small rooms and walled, long, narrow spaces yielded numerous manos (78), mostly broken (65, 83 percent). OS 6 (with 21 manos), OS 7 (7), and OS 8 (11) yielded the majority, along with many other broken discarded artifacts. Plaza Feature 1, built on Plaza 1, yielded 11 more manos, all broken. All of these mentioned above were associated with early A.D. 1100s ceramics.

Two rooms in the West Wing yielded the greatest number of manos. Room 103 (with 45) and Room 110 (with 54) were multifunctional habitation rooms with mealing bins (see Volume II, Chapter 3), so that the large numbers of ground stones are not surprising. When these rooms ceased to exist as habitation rooms, however, manos continued to be abundant in the associated deposits, which suggests that mealing activities continued nearby. Room 233, built in the early A.D. 1100s against Room 103, may have replaced the latter as a living room because manos were common in its deposits, and some were apparently thrown through its door into Room 103. Manos in the fill above the upper floor in Room 103 also suggest that grinding facilities may have existed on the roof. Nearby, manos were also common (n = 44) in the postoccupational fill in the structures built over Room 110 (Kiva 15 and Room 109), again suggesting former rooftop activities. The excavated rooms behind Room 110 (Rooms 112 and 229), however, contained only five fragments, all from Room 112.

In contrast, the 7 excavated rooms in the Central Roomblock contained few manos (n = 18). The vast majority were recovered in the roof deposits, primarily in the two rooms that had direct access to the plaza (Rooms 143 and 147). Although these rooms contained firepits, apparently the grinding facilities were located on the roofs above, at least when the site was abandoned in the A.D. 1130s or 1140s. Room 143 yielded 8 manos

(6 whole) and Room 147 yielded 5 manos (1 whole). Like the West Wing, the Central Roomblock rooms behind the rooms adjacent to the plaza yielded almost no manos.

Manos and mano fragments were rare in trash deposits. We discovered only 26 (25 were fragments) in the huge volume of trash excavated (73 m^3) in the Trash Mound. A number of trash-filled court kivas in Plaza 1 also yielded few or no manos and mano fragments. Kiva 10, for instance, yielded only six mano fragments from 14 m^3 of excavated trash fill despite its proximity to potential rooftop mealing areas and living rooms. Along the arc enclosing the south side of Plaza 1, however, broken and whole manos were prolific, along with other discarded artifacts. This anomaly may mark a different discard behavior for inhabitants living in the new, early A.D. 1100s room additions to the arc, or may be related to construction materials different from the primary buildings. Because ground stone tools were often reused in construction during the A.D. 1100s in Chaco Canyon, I believe that the majority of mano fragments associated with the arc structures derived from the fallen walls with which they were associated rather than from discard.

Summary

On the whole, there was little variation among the manos recovered from Pueblo Alto. The principal differences were in cross section and weight, which were affected primarily by the duration of mano use in trough metates and the user's motor skills. One thin type, however, appeared to have remained relatively unaltered from wear and may have comprised one of two major types. The remainder apparently were derived from a large, blocky type of mano. The large, blocky type and the thin, tabular types were sometimes found together in the same mealing bins and presumably were used on the same metate. T-test comparisons between the two types suggest that the differences between them are not fortuitous when based on dimensions and grinding surface areas. Presumably the differences between the two types of mano were related to function. Whether both types were used for food reduction or for crushing different kinds of materials (e.g., food and nonfood) is unknown, however.

Broken manos were curated for reuse as other tools or for construction but seldom discarded in trash deposits. The location of some broken manos in and around the mealing bins at Pueblo Alto suggests that mano fragments continued to be used in conjunction with mealing activities. Because of the high numbers of manos and mano fragments associated with mealing bins at Alto, it is presumed that other concentrations of manos at the site reflect former mealing areas. If this is true, then mealing activities apparently continued to be localized in the West Wing rooms after the abandonment of the A.D. 1000s living rooms there, probably in the new additions or on the rooftops in the early A.D. 1100s--a pattern repeated in the Central Roomblock. A plethora of manos and mano fragments associated with the early A.D. 1100s arc of narrow rooms and irregular structures enclosing the interior plaza along the south side, however, may mark extensive use of manos in construction rather than loci for mealing

activities. Nevertheless, the smaller grinding surfaces of these manos contrast with those recovered with the mealing bins in Room 110. Applying Hard's (1986:105) arguments that grinding areas increase as the role of cultigens increase, then the early A.D. 1100s at Pueblo Alto might reflect a decrease of cultigens and an increase in the processing of wild plant seeds compared to the previous period. A greater reliance on the use of wild plants did occur in the early A.D. 1100s (M. Toll 1985:Table 5.11; M. Toll, this volume) but fewer species were utilized than in the preceding period.

Metates

Three whole metates were recovered from Pueblo Alto, all from early A.D. 1100s contexts, but fragments (338) were widespread at the site. Another 11 metates were nearly whole or were reconstructible from fragments. There was no evidence of slab metates (e.g., those without a trough) at Pueblo Alto, although their use was common in the A.D. 1000s in the San Juan District, an area north of Chaco Canyon that was linked to Chaco by prehistoric roads. All metates at Pueblo Alto were of the trough variety, open at one end, except for two fragments that revealed open troughs at both ends (from Kiva 10 and Other Structure 7). No basin metates nor "Utah" types (having a shelf at the back of the trough for resting a mano) were recovered.

Distribution

Distribution of metate fragments at Pueblo Alto was similar to that of manos. The West Wing living rooms (103 and 110) yielded the most, 46 and 15, respectively. Most of these (35) were recovered from the latest floor and the postoccupational deposits in Room 103. Another 31 specimens came from the fill in Kiva 15 and Room 109, structures overlying Room 110. As we have seen with the mano distribution, metate fragments decline sharply in rooms built behind those bordering the interior plaza--only four were recovered from the two excavated in the West Wing, all from Room 112. As was true of manos, the Central Roomblock revealed few metate fragments. Only 16 came from the 7 rooms excavated, with the majority from Room 142 (5) and Room 147 (4)--rooms directly behind a long, narrow room that opened onto the interior plaza and was common to both rooms.

As with manos, few metate fragments were recovered during wall clearing of the primary rooms at the site, but they were profuse in the trash-filled structures enclosing the southern side of the interior plaza. Long, narrow rooms there, designated as Other Structures, yielded 44 specimens, and the small, late rooms yielded an additional 27. The majority came from OS 6 (18), OS 7 (13), and OS 12 (5) and included 1 whole and 2 nearly whole metates. Plaza Feature 1, the small house built on the interior plaza, yielded an astounding 81 specimens (23 percent of the site total). The latter were mostly small fragments, although the structure yielded a whole and two nearly whole metates.

Temporally, most metates and metate fragments were associated with early A.D. 1100s deposits. The Trash Mound, of A.D. 1000s deposition, yielded a mere six small fragments from our testing. There was a similar paucity of items in the trash-filled court kivas of all periods. Kiva 10, which yielded quantities of artifacts, contributed just four metate fragments and a whole metate to the total. Kiva 2 yielded the most fragments for a pitstructure, seven, including a nearly whole metate.

Reuse

Metate fragments and worn-out metates were curated for reuse as a variety of other tools (Plate 4.14E) or for use in construction. Several whole or restorable metates had been struck by a blow to the center that left a "kill" hole or a fragmented metate (Plates 4.14A-B, E and 4.15C). Given the paucity of whole metates at the site, it seems likely that worn-out specimens were broken for reuse. For this reason, like manos, they were seldom discarded in trash deposits. Distribution of these, then, is often uninformative of specific food preparation loci. Metate fragments were commonly added to walls built in the early A.D. 1100s, although they were rare or absent in the primary Pueblo Alto construction as suggested by observation of the standing walls and the lack of manos among fallen primary walls. The preference for use of ground stones in late construction at Pueblo Alto is mirrored by its frequency in coeval construction at both greathouses and small houses in Chaco Canyon. The high frequency of metate fragments along the southern enclosing arc of the interior plaza and in Plaza Feature 1, all composed of late structures, is not surprising and probably reflects the use of ground stones as construction material. Five of the 11 nearly whole metates had been used in construction, and the remainder were found associated with wall rubble, which suggests that they, too, were used as construction blocks.

The dominance of metate fragments in the West Wing may reflect, however, the location of mealing bins there. No whole metates were recovered in association with the mealing bins so how may the fragments there be informative? Two possibilities come readily to mind. Metates no longer used for food preparation may have been curated nearby for other uses and would logically have had a high probability of reuse within areas controlled by the owners of the stones (i.e., in the same and adjacent rooms). On the other hand, the metates may have simply been abandoned in their bins and then, later, become sources for construction materials for construction projects nearby (e.g., the Kiva 15 construction over Room 110, the cross wall dividing Room 103, and the addition of Room 233 against Room 103). Either way, a greater density of metate fragments (and manos) is expected near former meal-grinding facilities.

In contrast, metate fragments were few in the Central Roomblock, where no mealing bins were discovered. A correlate to the reasoning above may be that the more grinding that is done in one area, or the longer that it is done there, the more worn-out metates become available for other uses. The critical assumption, however, relies on the thesis that worn-out metates are primarily reused near where they once were used for food

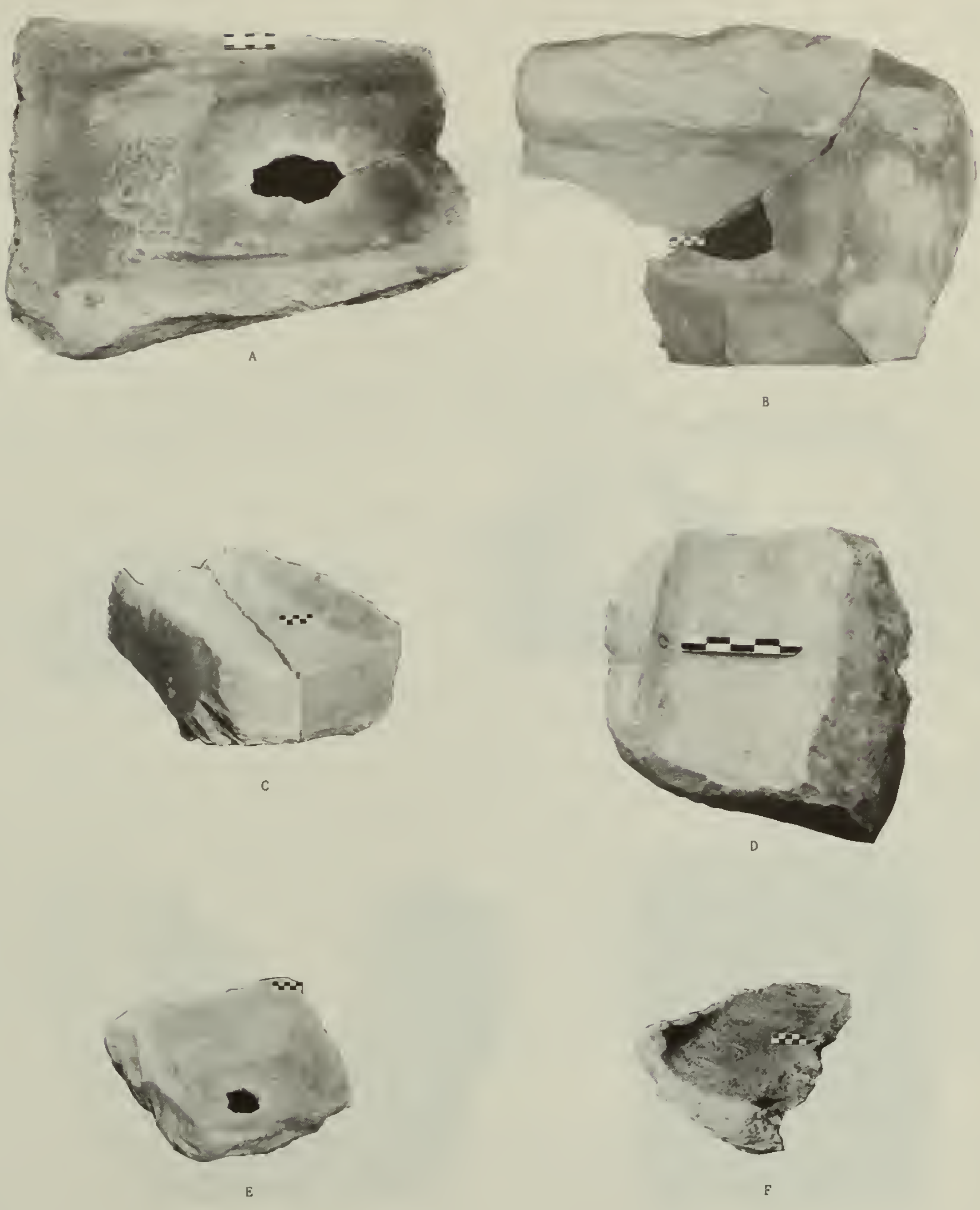


Plate 4.14. Trough metates (thick variety) from Pueblo Alto. 15-cm scales. A. From Plaza Feature 1, TT 1 (NPS#14199). B. From OS 6 (NPS#14030). C. From OS 9 (NPS#14049). D. From Kiva 10, Level 14 (NPS#17956). E. From Plaza Feature 1, TT 1 (NPS#14041). F. From OS 12 (NPS#14051).

Plate 4.15. Trough metates (thin variety except for F) from Pueblo Alto. 15-cm scales. A. From Room 103, Layer 2 roof fall (NPS# 14043). B. From Room 103, Layer 2 roof fall (NPS#14036). C. From Room 110, Niche 4, and Kiva 15, north wall and bench construction (NPS#23635). D. From Plaza Feature 1, TT 1 (NPS#14047). E. From OS 6, reshaped as a slab cover (NPS# 14201). F. Thick variety from OS 6 showing use with manos of different sizes (NPS#14070).

preparation. Given the distribution of fragments at Pueblo Alto, there appears to be some basis for this argument. It may also be that metates continued to be used in the same general areas after the living rooms (103 and 110) were abandoned in the late A.D. 1000s and that the metate fragments were mostly derived from these later activities, instead.

Aside from use in construction, metate fragments were also employed as tools. Eighteen of them served as anvils, 32 as choppers or crushers, and 22 as active or passive abraders. Another 18, or fewer, fragments were analyzed solely as abraders (Akins, this volume) that were not recorded under the metate analysis. Seventy-eight revealed multiple uses. In all, 140 of the 338 fragments (41 percent) revealed reuse aside from any use in construction. Seventy percent (41 of 59) of those from the West Wing not used in construction had been reused as other tools or artifacts. In addition, 32 specimens were built into the excavated site floor or wall features; the largest lot (13) were used in the walls and benches of Kiva 15. Only 11 of these 32 (34 percent) revealed secondary use.

In contrast, metate fragments associated with wall rubble throughout the site exhibited less reuse as artifacts (43 of 134 specimens, 32 percent) than those fragments recovered from room floors and fill. This interesting dichotomy suggests that metate fragments were often reused as tools in and around living rooms, such as those in the West Wing, but otherwise ended up in construction. It appears that there was a curation strategy that kept some fragments for a variety of tasks around the home while the remainder were stockpiled for construction purposes.

Burned metate fragments (20 percent of the total) indicate that many were used in hearth construction. Only 14 of the 134 specimens (10 percent) associated with wall rubble were burned, but another 54 burned specimens must have been used at one time or another in firepits. Burned fragments were particularly prevalent in Room 3 of Plaza Feature 1, the location of three huge ovens (see Volume II). In that room, 25 of the 47 fragments were burned. Seven burned fragments were associated with burned stones recovered from the ovens or were built in the oven walls. The majority came from the postoccupational fill and may have been dumped there from adjoining unexcavated rooms that had ovens. Otherwise, there does not appear to be a correlation between rooms with firepits and burned metate fragments.

One metate fragment revealed hematite paint and probably was used as a paint palette. There was no evidence, however, that ores for paint were being ground on metates, although two metates whose troughs were smeared with red paint were recovered from nearby Pueblo Bonito and are now in the American Museum of Natural History.

Materials and Forms

All of the metates and metate fragments recovered from Pueblo Alto were made of a local hard or very hard, fine-grained sandstone. There is little variation in the surface texture, and, generally, the metates were

similar to those recovered from other sites in the canyon (see Schelberg 1987).

Dimensions and weights of the whole and restorable Pueblo Alto metates are similar to whole metates recovered from a sample of four small-house sites of contemporary or nearly contemporary age (Table 4.14). Two types of metates were used at Alto, but typically only the massive, deep-troughed type found at Alto (Plate 4.14-4.15) was also common in the small-house sites. The thick type was the only form recovered whole at Alto, which contributes to the similarity between the Alto and small-house samples in Table 4.14. A thin, tabular, trough-shaped metate type also common to Alto (Plate 4.15) was reminiscent of forms common to Basketmaker III and Pueblo I (A.D. 500-800) periods in Chaco Canyon. Judd (1954:135-137) also noted two forms of metates recovered from Pueblo Bonito (see Plate 4.16) and attributed them to different periods. Unfortunately, the variable for metate thickness was scrambled in the computer files so that a clear dichotomy of metate types is not possible with the data. Some support for the dichotomy at Alto is shown by the histogram of trough depths, which reveals that shallow metate troughs were more common at Alto than at small-house sites (Figure 4.3).

Because no metates were found in situ at Pueblo Alto, it is difficult to distinguish separate roles for the two forms. Traditionally, portable metates (those not set in bins) were the thick, deep-trough types encountered so frequently on Pueblo II and Pueblo III sites (e.g., Plate 4.16). Flat, slab metates were generally set in enclosed bins (e.g., at Pueblo del Arroyo; Judd 1959:Plate 48). The difference in meal spillage should be obvious--slab metates must be enclosed or the material being ground will spill off the sides, a great inconvenience. The thin, tabular metates at Pueblo Alto are analogous to slab metates. The grinding trough is so shallow (1-3 cm) that meal must have inevitably spilled off the sides unless the metate was enclosed. These were not simply new, barely worn metates because the metates were barely thicker than the trough depth. It seems reasonable to postulate that the thin, tabular metates were set in bins at Alto, whereas the others were portable. Interestingly, Morris (1928:369) found three shallow trough-shaped metates set in a row of bins at the Aztec Ruin, although he was perplexed by their presence rather than true slab metates.

The hypothesis that thin metates were used in the mealing bins can be tested, given the metate fragment distribution at the site. Because bins were only associated with the A.D. 1000s occupation of the living rooms, they may not have been common afterwards. If this were true, trough depths should be significantly shallower for fragments associated with the A.D. 1000s period compared to the early A.D. 1100s. We have no way of knowing how much reuse of A.D. 1000s fragments might have occurred in the 1100s, but it is reasonable to expect that the approximately 40 years of early A.D. 1100s occupation would have produced numeric metate superiority over the remaining A.D. 1000s specimens still in circulation, particularly if the population was larger (see Volume I, Chapter 11). Both types of metates might have been coeval for one or both periods, which would bias results, however.

Table 4.14. A comparison of whole metates from Pueblo Alto and four small-house sites in Chaco Canyon.[a]

Pueblo Alto	Number	Mean	sd	CV %	Range
Length (cm)	14	51.8	9.3	18.0	40 - 70
Width (cm)	14	36.8	8.2	22.3	24 - 52
Thickness (cm)[b]	14	10.1	3.7	36.4	5 - 17
Weight (kg)	14	21.66	12.13	56.0	5.8 - 56.8
Trough length (cm)	14	44.9	6.5	14.5	34 - 55
Trough width (cm)	14	18.1	2.4	13.3	15 - 24
Trough depth (cm)	14	6.4	2.7	41.3	3 - 10
Trough angle (°)[c]	6	31.3	8.6	27.6	20 - 45
Small sites					
Length (cm)	35	49.6	7.1	14.3	37 - 66
Width (cm)	35	34.9	7.4	21.2	21 - 54
Thickness (cm)[b]	31	11.3	3.4	30.1	6 - 20
Weight (kg)	35	21.80	9.45	43.3	9.0 - 55.0
Trough length (cm)	35	41.1	5.5	13.3	30 - 51
Trough width (cm)	35	20.0	2.1	10.5	14 - 25
Trough depth (cm)	35	5.1	3.3	66.1	0 - 13
Trough angle (°)[c]	8	32.4	24.4	75.0	1 - 80

[a]Small sites = 29SJ 627, 29SJ 629, 29SJ 827 (Bc 362), and 29SJ 1360.
[b]Data variable corrected and recalculated after completion of this report.
[c]Measured at the lip of the open end.

Plate 4.16. A mealing room at Pueblo Bonito (Room 17) with evidences of white (corn) meal throughout the room (see Pepper 1920:84-85). Note the use of a single stone for multiple grinding troughs. Both thick and thin metates are present. (Courtesy of the Museum of New Mexico, MNM#6137).

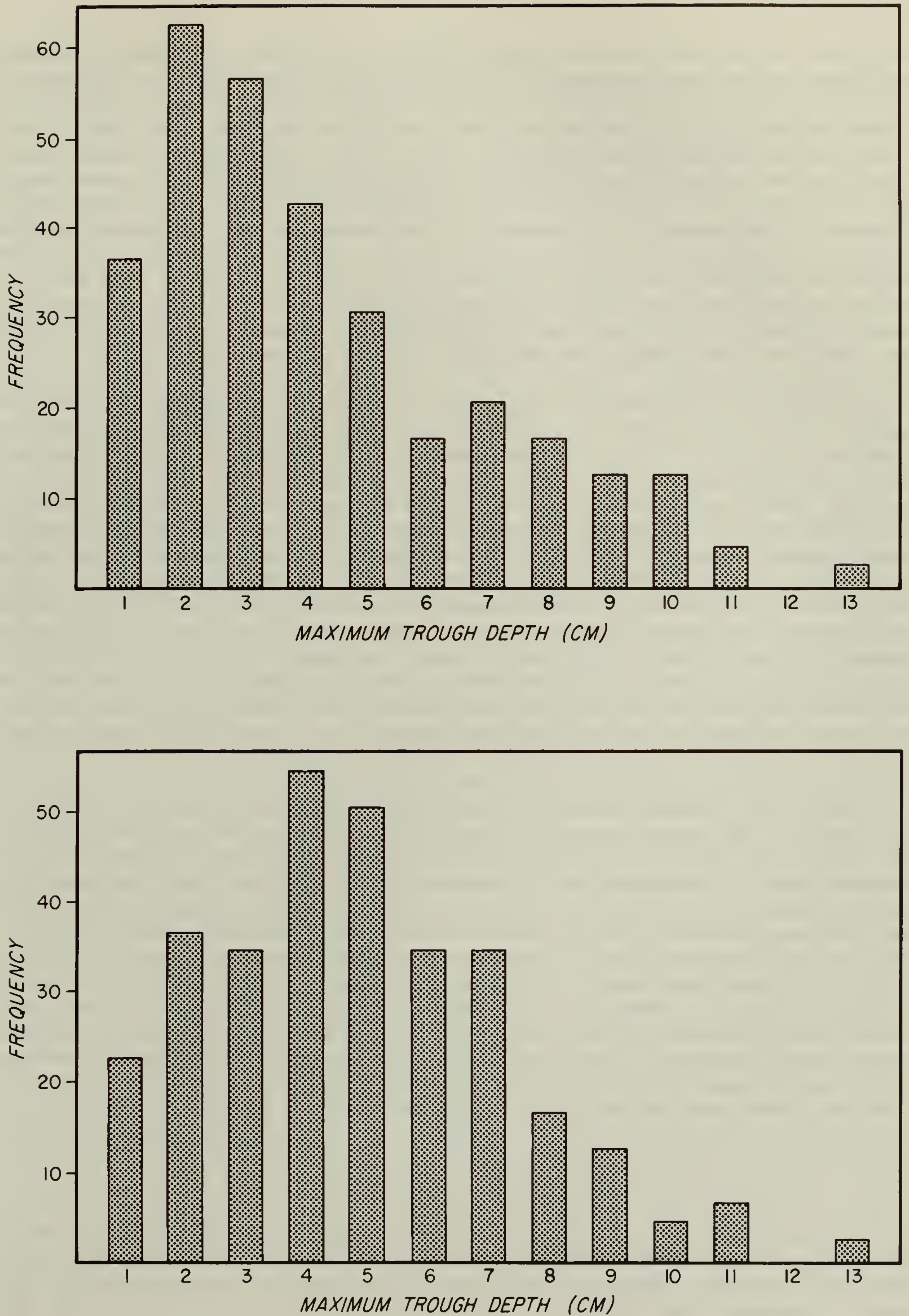


Figure 4.3. Comparison of metate trough depths between Pueblo Alto (A) and four contemporaneous small-house sites (B) in Chaco Canyon (29SJ 627, 29SJ 629, 29SJ 827, and 29SJ 1360).

The three whole metates recovered, all from late contexts, provide some clue as to the type of metates being used in the early A.D. 1100s. The trough depths are moderately deep to deep (3, 5, 9 cm) and suggest use of the thick, deep-trough metate type, although the sample is small. The 11 restorable metates were found in wall fall or were used in late A.D. 1000s or early 1100s construction. The trough depths of these range between 3 and 10 cm (mean 6.6 cm), also suggesting use of the thick type of metate. Examination of specific late proveniences also supports the probability that thick metates were favored in the late period. Metate fragments associated with Rooms 103 and 110, when the mealing bins were in use in them in the A.D. 1000s, however, suggest that only thin metates (at least in the living rooms) were being used. Trough depths for the 18 specimens recovered range between only 1 and 3 cm (mean 1.8 cm).

A t-test to assess the probablity that trough depth variability between the two periods was statistically similar for both groups was rejected at the .01 level of confidence ($t = 4.61$, $df = 155$, $p = 0.00$). Thus, the hypothesis that thin metates were used in the mealing bins in the A.D. 1000s and that portable, thick-trough metates dominated early A.D. 1100s use is supported. Inspection of the manos associated with the bins, however, revealed differences in the amount and shape of the edge wear that might be attributed to use on different metate types. The tabular Type 7 manos appeared to be longer than other types, with little edge deformation, and these might have been used solely on the thin, tabular metates. Lack of edge deformation was also noted only for some of the Type 1 manos, but this may be attributed to relatively little use of the mano rather than specific use on thin, tabular metates. If we had had any whole thin metates, a correspondence between mano length and metate trough width might have been established to strengthen the inferred relationship.

The metate fragments used in the construction of Kiva 15 at approximately A.D. 1080 (see Volume II) may provide an exact reference point for the shift from thin back to thick metates at Pueblo Alto. Although it was expected that the metates from the Room 103 and 110 mealing bins may have been scavenged for the Kiva 15 construction, when the trough depths were compared statistically, the fragments from the two rooms and kiva suggest that were not from a similar group of metates ($t = 3.9$, $df = 40$, $p = .0002$). On the other hand, the Kiva 15 fragments, based on trough depth, were more similar to those of the early A.D. 1100s ($t = 1.4$, $df = 161$, $p = .08$). The difference between Kiva 15 and the two rooms would be greater if the thin fragments from Kiva 15 that were part of a Room 110 metate (Plate 4.14C) were eliminated from the sample. Thus, the shift in metate types may have occurred at about A.D. 1080.

Summary and Conclusions

Metate fragments at the site were widespread and followed disposal patterns similar to those of manos. Few whole metates were recovered, and apparently worn-out ones were deliberately broken for curation and reuse. Metate fragments were common in areas of multifunctional living rooms (in

the West Wing) but rare in and around storage rooms (the Central Roomblock and behind rooms adjacent to the plaza). Fragments were also common to early A.D. 1100s rooms, where they were probably reused in the construction. Two kinds of metates were common at Pueblo Alto, a thick, deep-trough type and a thin-trough type. Although these may have been used contemporaneously, fragment disposition suggests that deep-trough, portable metates were typical of the early and late periods at the site, whereas thin, tabular metates dominated the mid-A.D. 1000s and were used in mealing bins.

Why was there a shift from portable to enclosed metates and back again at Pueblo Alto and, possibly, other sites? Shifts in the social organization, subsistence, or in occupational permanence might explain these changes. The change in metate types has been linked to a variety of factors, including the specialized use of corn (Bartlett 1933:9; Woodbury 1954:50), increased efficiency (Lancaster 1983:84), and subsistence changes (Bartlett 1933:28; Plog 1974:140-141).

Mealing bins might represent permanancy, whereas portable metates suggest intermittent occupation and the removal of the metates when the inhabitants leave. In Room 110, at least, floor features suggest that there was some shift from seasonal to permanent occupation (see Volumes I and II). Early occupation of the room, when bins were absent, was thought to reflect intermittent occupation, whereas when a permanent firepit was installed (suggesting permanent occupation), the mealing bins were added. Perhaps seasonal occupation in the cooler months of the year might require immobile, indoor mealing bins. With year-round occupation, practicality might demand that the metates be portable for inside and outside work.

Alternative explanations of the shifts in metate types are more convincing, however. The shifts coincide with a number of other events at the site besides occupation duration, including change in the use of space, change in the diversity and types of other artifacts, change in patterns of trash disposal, and changes in subsistence. Precipitation also may have been a critical factor in the shifting events at the site. Dry periods mark the beginning and end when mealing bins and, presumably, the thin, tabular metates were in use. Dry periods are thought to have affected cultivar production, particularly corn, the premier staple at the site, which resulted in greater reliance on wild plants. Corncobs were smaller in the late A.D. 1000s and the early A.D. 1100s, which is indicative of growth stress, while wild plant foods increased in diversity but not in abundance (M. Toll 1985:268, Table 5.11). In the early A.D. 1100s, occurrence of economic grasses peaked at Pueblo Alto but corn was more widespread than previously. The response in Chaco Canyon may have been to intensify cultivar production, for instance, by increased water control and specific wild plant utilization. Hard (1986:103-105) suggests that corn grinding should be more time consuming than the reducing of wild plant seeds, which are smaller than corn grains. The grinding surface areas of manos are larger in the A.D. 1000s than those for manos in the A.D. 1100s, which may support Hard's contention. Data comparing the surface grinding area of the metate types is not available, however.

The common denominator among the periods when there was a shift in metate types is not the use of corn, which was ubiquitous, but the use of wild plant foods (see M. Toll 1985:Table 5.11; M. Toll, this volume). When mealing bins and thin metates were in use, a great diversity of wild plants were used. Before that time and afterwards, when thick-trough metates were favored, there was less diversity but greater reliance on a few specific, economic weeds and grasses at the site. In summary, changes in the use of ground stone tools at Pueblo Alto may reflect subtle changes in the subsistence rather than indications of an overall, regional, evolutionary trend toward efficiency and complexity.

Summary of Manos and Metates

Two kinds of manos, a light and heavy type, were used in conjunction with mealing activities, although it is not known if both were used for food reduction or if they were used to crush different materials (e.g., economic and noneconomic). Both kinds were often paired at bins and presumably were used on the same metate. When manos were broken, they often continued to be used as tools supplemental to the food preparation process, perhaps as hammers and crushers. Some kinds of food, for instance small animals, may have been crushed on metates with hammers because small, whole animals have been found in human coprolites within Room 110 (Clary 1984:269) where mealing bins were located. Other mano fragments were used as other expedient tools or used in construction. Both manos and metates were rarely discarded as unusable, and they had a high curation and reuse rate. High numbers of manos and mano fragments may mark potential mealing loci that may lack other distinguishing characteristics.

At Pueblo Alto, mealing activities were localized in multifunctional living rooms in the West Wing. Metate types changed from thick, portable, trough types to stationary, thin, tabular metates set in slab-lined bins. Whether the thick, portable, trough types continued in use in locations different from the living rooms is unknown. Thick, trough metates became more popular in the early A.D. 1100s when mealing bins and the thin, tabular metates may have become obsolete. The shift in metate types may be related to changes in subsistence, specifically in the degree of importance of processed, wild plant foods.

A Mealing Bin Work Area at Pueblo Alto--A Special Case

Room 110 is one of the very few areas at Pueblo Alto where a case can be made that specific activities left in situ artifacts. This room was one of two, multifunctional, habitation rooms excavated in the West Wing (see Volume II) and, by an accident of preservation, a mealing bin complex was left partly intact because it was protected by later kiva construction. Six mealing bins and their catchment basins were left (Plate 4.3), surrounded by numerous manos, hammerstones, abraders (Figure 4.4), and a hammerstone/abrader (Plate 4.5A). Unfortunately, the metates had been removed and carried off.

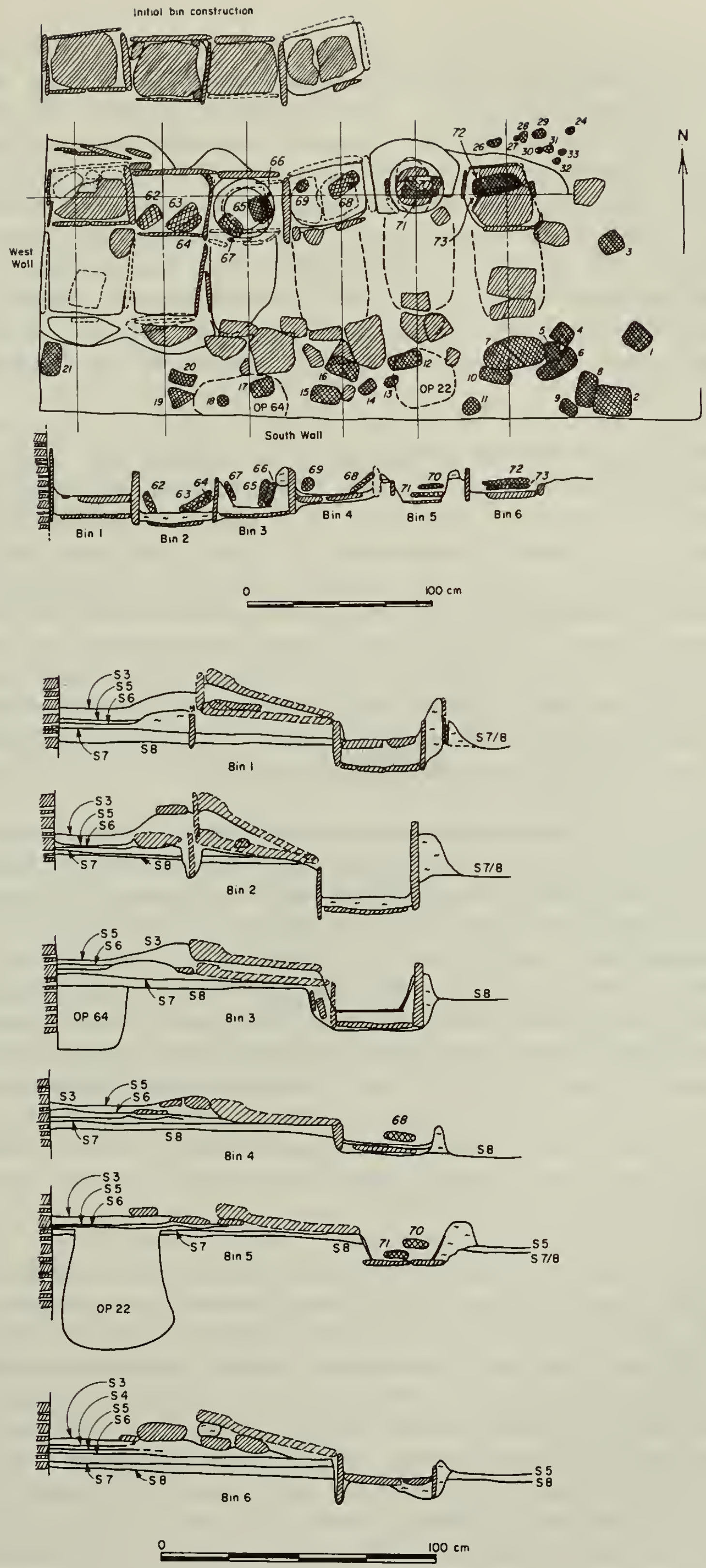


Figure 4.4. Plans and profiles of the mealing bins in Room 110. Numbers mark the locations of the associated tools (for a tool listing see Volume I, Table 3.7).

A number of other tools recovered from the fill just above the room or catch basin floors must also be considered associated with the floor assemblage despite their location in scattered trash. Broken tools from either floor or fill contexts are suspect and may have derived from elsewhere. The high density of broken and whole tools that typologically could be related to grinding activities, however, suggests a functional relationship for the many tools clustered around the bins (Plates 4.4, 4.10-4.13). This type of tool concentration is restricted to the area of the mealing bins in Room 110. A triad of tool types (manos, metates, and hammerstones) is so commonly found with mealing bins in archeological and historical sites that there can be little doubt of the inferred association.

The tools associated with the bins in Room 110 were not analyzed during the initial analyses. Except for abraders, they were examined specifically for this paper, and only a few attributes were recorded for presentation here. We were interested in the size and variation of the assemblage and whether or not we could elucidate meaningful patterning from its spatial arrangement. The distribution might be informative regarding two questions: (1) Were multiple bins stages in the food preparation process or (2) were they for processing different foods? In other words, could the tools be divided into subsets that might have reflected use with specific mealing bins and, if so, could they be informative for either of the two alternatives suggested above?

The six bins may represent two sets of three each, because three bins is a common set noted for prehistoric and historic sets (e.g., Volume I, Chapter 11). In addition, the original set in Room 110 consisted of three bins, as did all the sets in nearby Room 103. Finally, the two catch basin types associated with the six bins also suggests a dichotomous arrangement. Aside from the mealing bins, three other features may have played a role in the mealing activities. Two bell-shaped pits were located next to the mealing bins in the kneeling areas. One of these (OP 64), however, was associated with a floor surface that predates the mealing bins, although we do not know how long the pit remained in use. It exhibited a modest volume (19 liters) but contained a whole mano. Nevertheless, coprolite fragments suggest its abandonment along with other bell-shaped pits early in the use of Floor 1.

The other bell-shaped pit (OP 22) was constructed with the same floor in which the first four mealing bins were built. Only with the construction of Mealing Bin 5 would the pit's placement have been an awkward obstruction during mealing and, perhaps, it was abandoned then. It had a 40-liter capacity and contained a hammerstone and macroremains of corn and curcubits, a combination unique among the floor pits. The contents suggest an association of the pit with mealing activities. It must be cautioned, however, that many floor pits (e.g., the 74 Other Pits) contained one or more items also found with the mealing bins: corn was found in 25 pits (34 percent of all Other Pits), cucurbits in 2 (3 percent), hammerstones in 10 (14 percent), and manos in 4 (5 percent).

Finally, a large (107-liter) wall cavity (N 9) to the east of the row of mealing bins was built with earlier floors but modified several times. The last remodeling left a restricted access that could have made the cavity suitable for grinding equipment or grain storage. The entry had been constructed so that it could be sealed by a small slab. Two large, thin manos rested in soft sand just above the cavity floor, and nearby were two pieces of wood that may have been crude scoops or similar tools. Six unburned corncobs and one with kernels found in the fill, however, were believed by the excavator to have been cached by rodents. The proximity of the cavity to the bins, their coeval use, and the materials found inside the cavity suggest, nevertheless, that the entire contents may have been last associated with the nearby grinding activities. In addition, pollen from several economic wild plants (including sunflower, beeweed, buckwheat, cholla, and prickly pear) and an abundance of corn pollen, much of it clumped together, recovered from the niche floor also links the mealing bins and storage niche.

Ethnobotanical Evidence for Use of the Mealing Bins

Macro- and microbotanical remains provide some evidence of the foods processed in and around the bins (Clary 1987; Cully 1985; M. Toll, this volume). Flotation samples from Bins 1-3 yielded nothing despite the presence of corn, cucurbit, beeweed, purslane, and prickly-pear remains on the associated floor. Pollen from the six catchment basins, however, suggest the types of plants being processed in the bins (Table 4.15). Corn pollen was abundant throughout, whereas cucurbit pollen came from Bins 2-3 and 5, and beeweed and purslane came from Bin 2. The Bin 4 basin yielded quantities of prickly-pear fruit fragments and beeweed and cholla pollen. Cholla was also recovered from Bin 5. No pinyon remains were recovered from the bins, although pinyon shell fragments were found elsewhere in the room and in at least one room coprolite (Clary 1984). The paucity of economic pollen from Bin 6 suggests that the bin saw little use or that the sample was inadequate.

Summary

There can be little doubt that specialized food preparation took place at the mealing bins, dominated by corn reduction. The high percentage of corn pollen recovered from Bins 3 and 5 and the unusual catch basins with basket liners suggest that corn may have been the primary food reduced in these two bins. The presence of cactus pollen in Bins 4 and 5 may also mark specialized food reduction. Perhaps the two types of manos associated with the mealing bins reflect use for processing different kinds of foods. Nevertheless, it is clear that the mealing bins were an area for food preparation for the reduction of economic grains and plants and that OP 22, OP 64, and N 9 were probably used for food storage in conjunction with these activities. The remains, however, do not clarify whether the increase in the number of mealing bins in Room 110 resulted in more specialized or increased food production or both.

Table 4.15. Results of pollen analyses of mealing bin and Wall Niche 9 samples from Room 110 at Pueblo Alto.[a]

TAXON:	FEATURES[b]						
Arboreal Pollen	MB1 %	MB2 %	MB3 %	MB4 %	MB5 %	MB6 %	WN9 %
Abies (fir)	+	+		1			
Picea (spruce)				+			
Pinus (pine)	57	13	16	13	2		7
Pinus edulis (pinyon)				12	11	24	7
Pinus ponderosa (ponderosa pine)				21	8	12	5
Juniperus (juniper)					1		+
Betula (birch)					+		
Populus (cottonwood)		+					
Quercus (oak)			1				
Salix (willow)			1		+		
Alnus (alder)				+			
Celtis (hackberry)					+		
Ulmus (elm)				+			+
Oleaceae (olive family)			1				
Acer (maple)	+				1		
Non-Arboreal Pollen							
Artemisia (sagebrush)	+	4	2				
Ephedra (Mormon tea)	+	+	1				
Sarcobatus (greasewood)		+					
Cylindropuntia (cholla cactus)				1	1		+
Platyopuntia (prickly pear)				5[c]	1[c]		2
Parthenocissus (Virginia creeper)		+					
Poaceae (grasses)	5	11	14	1	1		1
Cheno-ams (Chenopodiaceae-*Amaranthus*)	6	15	3	2	1	6	7
Compositae (sunflower family)							
Low-spine Asteraceae (spines <2 microns)	3	1		1	2		+
High-spine Asteraceae (spines >2 microns)	4	+		1	2[c]		1
Ambrosia (ragweed)				1		12	
Sphaeralcea (globemallow)			1	+[c]	1		
Portulaca (purslane)		+					
Cleome (beeweed)		1		1[c]			+
Eriogonum (buckwheat)					+		+
Cruciferae (mustard family)		+					
Cucurbita (squash or gourd)		1	1		+		+
Zea mays (corn)	20	47	61	38[c]	63	47	68[c]
Other[d]	+	5	1				
Unknown				+	1		
Sums							
Total Percent	95	98	103	98	96	101	98
Total Number	102	227	213	217	220	17	208
Absolute number of grains/ grams of sediment	---	---	---	4,982	1,359	224	17,417

[a]After Clary (1987:Table 1) and Cully (1985:Table 4.7).
[b]"+" - Indicates a frequency of less than 1 percent.
[c]Aggregates or clumps of pollen were noted by Clary.
[d]For other taxa, see Cully (1985).

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Chapter Five

The Abraders of Pueblo Alto

Nancy J. Akins

The original intent of the Chaco Project ground stone analyses was an artifact study based on materials from all sites rather than site-specific reports. A more detailed description of the analysis, the types, and the attributes can be found in Akins (in preparation). The following is a brief summary of the subtype definitions followed by a series of observations concerning Pueblo Alto and how it compares with the other sites in the sample.

As used in this study, the term abrader refers to a group of multifunctional and nondistinctive grinding stones, not all of which are tools. The original analysis and report was directed toward making sense of such a large and heterogeneous group. Determination of function and creation of a taxonomy were the main goals. The entire sample collected during excavations in Chaco Canyon consisted of 2,215 artifacts of which 839 (37.9 percent) were from Pueblo Alto. The sample was divided into 32 subtypes, 25 of which were found at Pueblo Alto. Because no one site had more than a few of any subtype (other than the "undifferentiated" groups), the focus was on determining the attributes of the subtypes rather than characterizing the differences between site assemblages. Very few abraders were found in a primary context that would suggest a function.

Five broad types of abraders were distinguished: active abraders, passive abraders, grooved abraders, polishing stones, and anvils. Briefly, active are those used actively or hand held; passive are stationary, on which another object is actively used; grooved are deeply grooved, such as shaft smoothers; polishing stones are pebbles used in an active manner; and anvils are similar to passive in that they are stationary but the primary use was characterized by pitting, gouging, or cutting, and may not have grinding surfaces.

A number of specific subtypes were defined within each type. Their characteristics are summarized in the following sections.

Active Abraders

Subtype 10 Active Abraders

This was considered the undifferentiated category for the active abraders. They were divided into hard and soft varieties. Most were made of sandstone. The soft variety was generally small, about hand-sized, and most often irregularly shaped with little indication of manufacture. Similar tools have been suggested as representing woodworking tools (Hayes 1975; Rohn 1971). Sixty were recovered from Pueblo Alto, and 21 of those were from the Trash Mound, which suggests they were not valuable or difficult to replace.

The hard variety undoubtedly includes a number of functionally distinct tools and comprised the largest group of artifacts in the analysis. Compared to the soft, active abraders, these were slightly larger in all dimensions except thickness. All but three were hard or very hard sandstones and many (39.4 percent) were made from fragments of other tools, usually manos (34.6 percent). About a third were manufactured but the alteration was only slight or moderate. Use was rarely heavy (0.2 percent), suggesting that most were expediently made and used. Striations were the most commonly recorded wear with edge-rounding occurring in over half of the cases (Plate 5.1).

Hard abraders could have been used for working a variety of materials, such as stone, as well as for smoothing soft, pliable materials such as clay. The surfaces are smooth, and they would not have been efficient for grinding seeds but could have served to powder meal, once it was broken down. The incidence of hard, active abraders increases over time, possibly replacing polishing stones in function.

Subtype 11 Faceted Active Abraders

Abraders with distinctive edge facets were first recognized at the stone circle sites in Chaco (Windes 1978). The facets occur at adjacent non-right angles to the main surface. Although only 40 were recovered from the Chaco excavations, almost half (19) were from Pueblo Alto. Most were hard or very hard sandstones, but soft and medium varieties did occur (20 percent). Little work was invested in these tools, although almost half were considered rectilinear in shape. Use was usually moderate.

The number of use surfaces on these abraders ranged from 1 to 12 with 4 where only an edge facet was ground and the main faces were unused. Two to four use surfaces were most common. Beyond one-handed, active grinding, the primary function of these tools is difficult to determine. Nearly all had striations, and their abundance at Pueblo Alto and the stone circles suggests they may have been used for working building stone. The incidence is slightly higher in larger sites, although the incidence is always low (Plate 5.2).

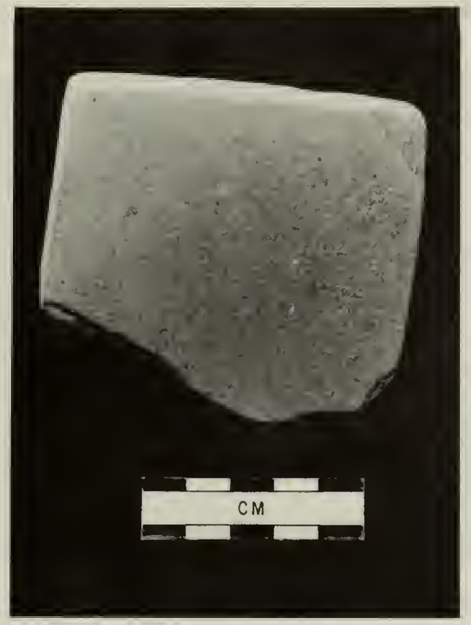

Plate 5.1. Subtype 10: A well shaped hard active abrader from Pueblo Alto, Other Structure 7, wall clearing. FS #464.

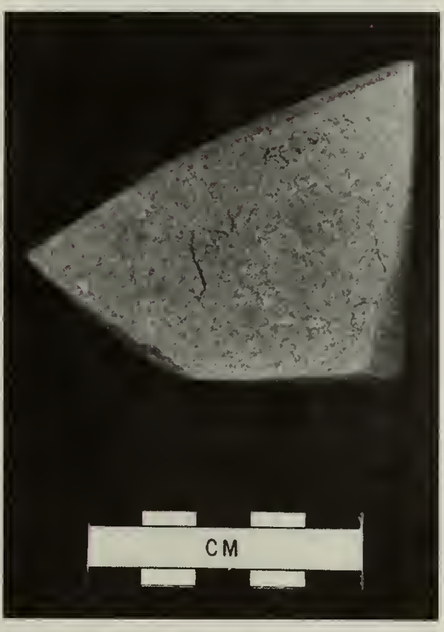

Plate 5.2. Subtype 11: A faceted abrader from Pueblo Alto, Room 146, Layer 3. FS #6002.

Subtype 12 Active Lapidary Abraders

Only 25 tools considered active lapidary stones were recovered from all of the sites; 12 were from Pueblo Alto. These were thought to have been used in lapidary or ornament manufacture. Some were assigned to this group on the basis of the context of occurrence and others because of their similarity to those in context or some illustrated by Judd (1954: Figures 13 and 14). Two kinds are included: a small, file-like set of tools and a larger rectilinear abrader. Special functions are suggested by the fact that these were not modifications of other forms and by the amount of effort invested in their manufacture. Both faces and the edges were commonly used.

This group of tools was most likely used in the final stages of ornament manufacture for grinding off projections and polishing (Plate 5.3).

Subtype 13 Mano-like Abraders

This abrader type was defined midway through the analysis; thus, it is recorded for only Pueblo Alto and Una Vida. It was present at 29SJ 627 and appears to be restricted to Pueblo II and later sites. The wear on these sets them apart from other mano-like objects. The surfaces are often polished to a glassy sheen, and the striations parallel the long axis of the artifact. They are also the largest of the active abrader types, designed for use with two hands.

Over half did not have a previous form, but many (40.3 percent) were made from discarded manos. The most common number of use surfaces is three for a triangular cross section (35.4 percent). A large number had a secondary use of chopping, possibly in conjunction with the primary use.

Mano-like abraders are often found in the same proveniences as manos and might have been related to the maintenance of the mano and metate tool kit or used in food preparation. The hardness of the stone and longitudinal striation suggest use on a hard material (Plate 5.4).

Subtype 14 Stones Abraded for Pigment

These are not tools, but rather chunks of colorful sandstone that were actively ground to produce pigment or colored sand. They are considered abraders because of their similarity in form. Active abraders were used to grind or shape another material, while these stones were apparently meant to be ground themselves. Three of these were recovered from Pueblo Alto.

The hardness of the sandstone was evenly divided between the softer and harder varieties (see Akins 1980 for determination of hardness).

Plate 5.3. Subtype 12: An active lapidary abrader from Pueblo Alto, Room 142, Layer 5. FS #2714.

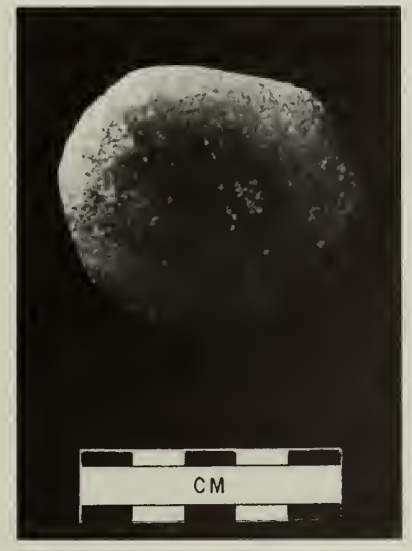

Plate 5.4. Subtype 13: Mano-like Abrader

Seven were concretions. Most (88.2 percent) had a single, ground surface.

Subtype 15 Paint Grinders

These active abraders were distinguished because their entire surface was covered by pigment. There are undoubtedly many instances where paint grinders had the pigment completely washed or worn off. Separation of these latter types might help to distinguish others. Only thirteen were found, six from Pueblo Alto.

In general, these did not appear to have been manufactured for this specific purpose but are, like most of the abraders, pieces of other artifacts used for that purpose (79.9 percent were pieces of manos). Extent of manufacture was absent to moderate and the amount of use moderate to light.

As a group, the paint-grinding stones are similar in size, material, and other features, indicating that some selection for a combination of features was made.

Subtype 16 Edge Abraders

This subtype of abrader is characterized by the use occurring on an edge rather than on the largest plane of the object, and the large planes are generally unutilized. Twenty-four of these were found, 14 from Pueblo Alto.

They are usually fairly small stones, only 2-13 cm long or wide and 1-3 cm thick. They were evenly divided between the hard and softer sandstones, rarely had previous forms or uses, and most were unmodified. Use surfaces numbered from 1 to 5 per item with an average of 1.9. Because half had more than one ground edge, it seems reasonable to suggest that they were not building stones. They were found in a number of different contexts, but room fill was the most common, followed by floor fill/floor contact, wall clearing, trash areas, and plaza proveniences.

Subtype 19 Abrader-Anvils

Active abrader and anvil uses are often found on the same surface of one tool. When the use did not appear incidental, they were placed in this category. Sixty-five were recovered, 26 from Pueblo Alto.

Both one-hand and two-hand varieties appear to be represented, although the smaller are more common. Most (89.2 percent) were hard sandstones, and more than half were modified. Single- and double-use surfaces account for most (89.8 percent), and all were characterized by both grinding and cutting or gouging.

Abrader-anvils appear to represent a multifunctional group of tools. The dual use could involve anything from wood or bone to the hard materials used in the manufacture of ornaments. Fourteen of these (21.5 percent) were found in floor fill or floor associations of rooms, kivas, and work areas, which suggests they were a common household object (Plate 5.5).

Passive Abraders

The main features that distinguish passive abraders from active abraders result from their passive use. They are generally larger, and, whereas the wear on the surface of an active abrader entails an entire surface, wear on a passive can be partial because the object worked on the surface may not be as large as the passive abrader. Again, they are usually unspecialized and were probably used mainly to grind materials such as pigments, clays, and possibly seeds. They may have served, also, as working surfaces for soft materials such as plants or hide.

Subtype 20 Passive Abraders

The undifferentiated group of passive abraders was the second largest of the groups analyzed (294), of which 66.2 percent were from Pueblo Alto. Included were a variety of grinding stones including lapstones and sandal lasts, and the sizes ranged from small, hand-held objects to immobile ones. Most were hard sandstones but soft and medium did occur (23.3 percent). The forms tended to be irregular or were unknown, and more than half had been made from other objects. Fewer than half had been modified, with the most effort expended on the lapstones and sandal lasts. Single or double, slightly concave surfaces were characteristic, and all kinds of wear were found on them.

Subtype 21 Passive Abrader-Anvil

Like the active abrader-anvil combination, a passive abrader anvil combination was also fairly common. These exhibited the ground or partially ground, slightly concave surface of the passive abrader, with the pitting, gouging, or cutting wear of the anvil. Eighty-one of these were analyzed, 15 from Pueblo Alto. It appears that this tool is more common in small Pueblo II sites as Pueblo Alto accounts for only 18.5 percent of those analyzed compared to 37.0 percent for 29SJ 627 and 11.1 percent for 29SJ 629.

There was a variety of sizes and materials used, with 22.2 percent of soft or medium sandstones. The rest were hard with the exception of two made from siltstones. Nearly all had some indications of manufacture, and wear was usually moderate. Over half had two use surfaces, and up to five were found. Rohn (1971) has suggested that similar objects were used as

Plate 5.5. Subtype 19: An abrader-anvil from Pueblo Alto, Room 153, wall clearing. FS #252.

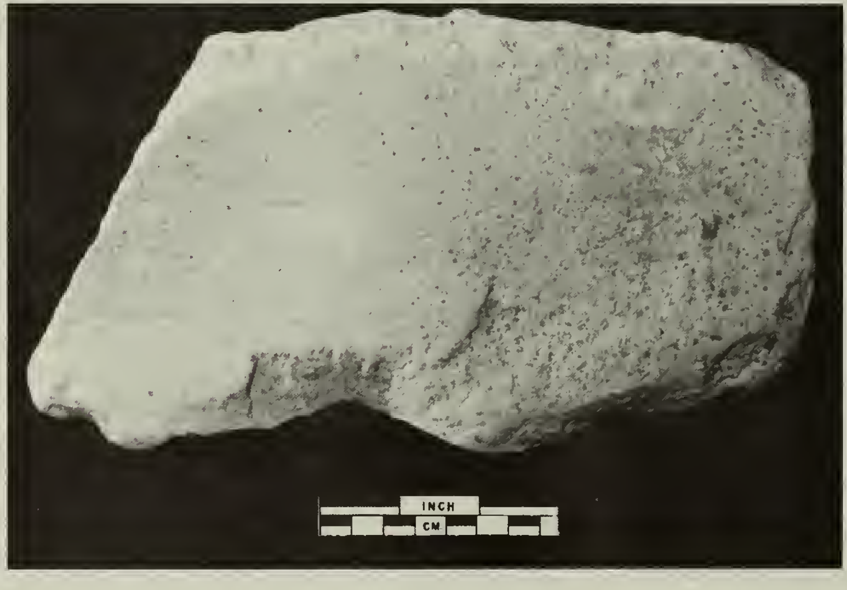

Plate 5.6. Subtype 20: A soft sandstone passive abrader from Pueblo Alto, Room 103, floor fill. FS #1137.

surfaces for removing the pulp from yuccas. He felt such action would account for the smooth, slick surface with rounded edges and the polished, slightly concavo-convex surfaces. The variability in our samples suggests a multitude of other uses as well (Plate 5.6).

Subtype 22 Passive Lapidary Abraders

Very few of the lapidary abraders in the sample of 118 were from Pueblo Alto (5 or 4.2 percent). They were much more common from the small sites where 70.3 percent came from 29SJ 629, which suggests that ornament manufacture was not as common at the greathouses or that our excavations did not uncover such activity areas. Those found appear to have been discards (Plate 5.7).

Again, materials varied, but hard sandstones were the most common. They tend toward rectilinear shapes, and few were made from pieces of other tools or were modified to the extent that a previous form was not evident. Half had no modification at all but of those modified 23.4 percent were moderately and 28.3 percent were extensively worked.

Subtype 24 Mortars

Six mortars were identified in the analysis, and all were from Pueblo Alto, probably because of the large sample from this site. However, they could also represent activities that did not take place at the smaller sites. Three of these appear to be mortars (Plate 5.8) and one is a paint mortar (Plate 5.9). Two others were depressions pecked in stones but without the characteristic mortar grinding (Plate 5.10). All of these were of hard sandstone, and the two mortars were made from concretions. No wear, other than grinding, was found on these tools. All but the paint mortar came from wall-clearing proveniences.

Subtype 26 Undifferentiated Palettes

Passive abraders with pigment stains that appear to have been primarily made and used as palettes were rare. A total of five was recovered; one was from Pueblo Alto. All were of hard sandstone and varied in size, manufacture, and use.

Subtype 28 Incidental Palettes

More common (24) were pieces of sandstone or tools used to grind pigment. Most (66.7 percent) of these were from Pueblo Alto. Nearly all were hard sandstone, but one of banded chert was recovered. Use was light, and all but three had single-use areas that were often irregular. One-third were found on floors or in floor-association contexts of rooms or pitstructures.

Plate 5.7. Subtype 22: A small passive lapidary abrader from Pueblo Alto, Trash Mound Grid 53, Layer 58. FS #4799.

Plate 5.8. Subtype 24: A mortar from Pueblo Alto, Room 200, wall clearing. FS #441.

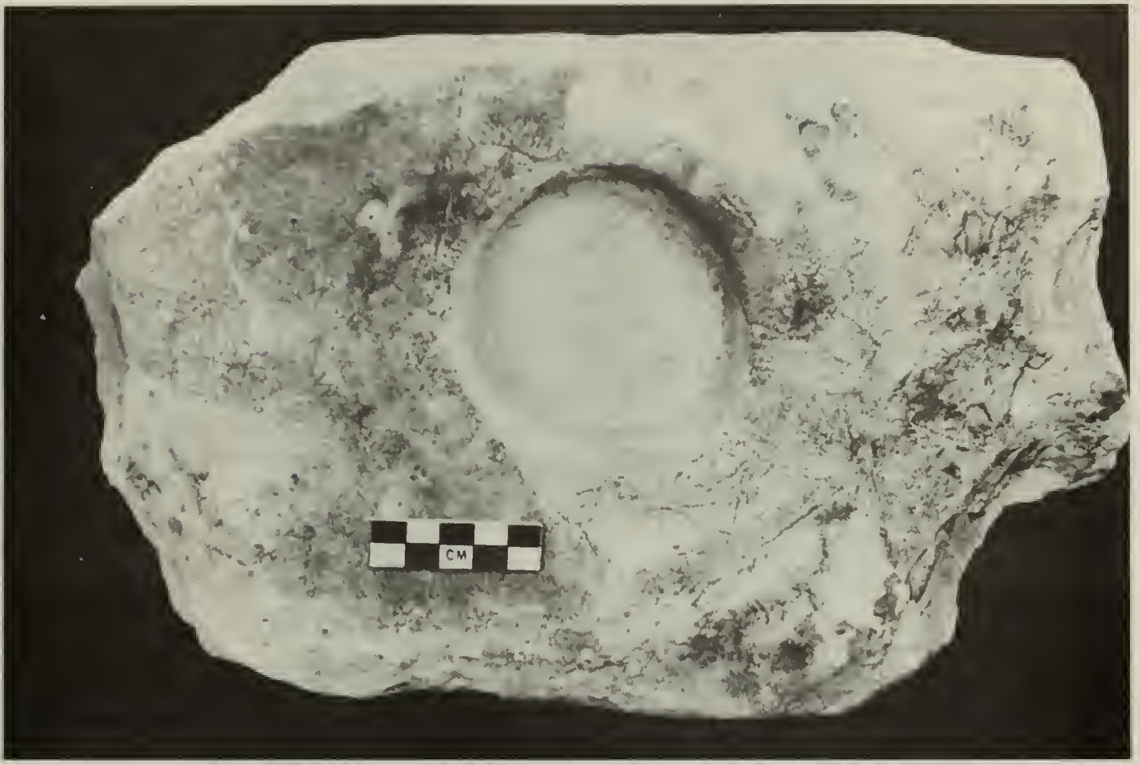

Plate 5.9. Subtype 25: A paint mortar from Pueblo Alto, Room 103, floor fill. FS #1138.

Plate 5.10. Subtype 25: A pecked hole abrader from Pueblo Alto, Room 127, wall clearing. FS #230.

Grooved Abraders

Suggested uses for grooved abraders include shaft smoothing, awl sharpening, smoothing of cotton yarn, preparation of materials for basket-making, shaping of perforated beads, and wood-working (Woodbury 1954).

Subtype 30 Undifferentiated Grooved Abraders

Thirty-five grooved abraders where the use was unclear were recovered. Eighteen (54.5 percent) were from Pueblo Alto. Most were fairly small with the largest dimension recorded a 26-cm length. Soft sandstone (87.9 percent) was the most common material, but one was of quartzite. The softer variety would have been best for shaping reed or wooden shafts whereas bone would probably require a harder material. The very hard materials were most likely for polishing or straightening rather than shaping. None of these had been made from other tools, and multiple use areas were common (61.4 percent of the tools) (Plate 5.11).

Subtype 31 Shaft Shapers

Nine objects that appear to represent shaft shapers were found (four from Pueblo Alto). These had fairly long grooves of uniform, shaft-like diameters. All were of fine-grained sandstone, and most had more than one use surface (an average of 3.4 per tool).

Subtype 32 Decorative Grooved Rocks

Four (one from Pueblo Alto) rocks that were grooved for decoration were recovered. Rather than subsume these into a tool group, we placed them in their own category. Attributes varied; all kinds of sandstone, surface contours, and numbers of surfaces were noted (Plate 5.12).

Subtype 33 Point Sharpener

One object used to sharpen the point of a small object, such as an awl, was found at Pueblo Alto. It was of fine-grained, medium-hard sandstone and had been used as an abrader.

Polishing Stones

Subtype 40 Undifferentiated Polishers

Polishers are cobbles used for polishing surfaces, such as those of clay pots and floors. Other uses are likely, but because these are cob-

Plate 5.11. Subtype 30: A grooved abrader from Pueblo Alto, Kiva 15, Layer 7. FS #5347.

Plate 5.12. A decorative grooved rock from Pueblo Alto, Room 213, wall clearing. FS #555.

bles, they wear differently than do active abraders. Polishers are more common in the earlier sites. Pueblo Alto had only 17 (9.0 percent) of the undifferentiated polishers, and none were considered pot polishers (Plate 5.13).

Quartzite was the most common material (83.1 percent), but cobbles of sandstone, metamorphic rocks, granite, igneous rocks, cherts, and quartz were present. Use was usually double-sided (67.8 percent), and most had convex or slightly convex surfaces. Almost all were used occasionally as hammerstones. These definitely appear to be replaced by active abraders in the later sites. The three latest sites have site totals representing only 1 or 2 percent of all abraders, while it ranges from 23 to 62 percent in Basketmaker-Pueblo I sites and from 13 to 30 percent in Pueblo II small sites. The one small Pueblo III site has a small (2 percent) total, suggesting that the difference is mainly chronological rather than due to site type.

Subtype 42 Large Polishers

Pueblo Alto had two large polishers. This type tends to be larger than the undifferentiated types and about hand-sized. Again, most were quartzite (66.7 percent) with others of sandstone, metamorphic, granite, and igneous cobbles. Otherwise, they are very similar to the undifferentiated group.

Anvils

Anvils are generally informal tools consisting of almost anything that was used as a work surface. The existence of pitting, gouging, or cutting was the criterion for placement in this group.

Subtype 50 Undifferentiated Anvils

This was the third largest group of abraders in the sample, totaling 246. Almost a third (32.1 percent), or 79, were from Pueblo Alto. As with the other undifferentiated groups with fairly large samples, the size of these objects varied greatly--from hand-held to immobile masses. The material was usually hard sandstone, but the softer sandstones (16.3 percent) and quartzite (2.4 percent) were also found. Otherwise, extent of manufacture, amount of use, and number and character of the surfaces varied considerably. Every kind of wear imaginable was found on these, attesting to their multifunctional character (Plate 5.14).

Subtype 51 Anvil-Abraders

Tools that exhibited anvil wear on one surface and active-abrader wear on the opposite were placed in this category. Thirty-five were recognized, 12 (34.3 percent) from Pueblo Alto. These tend toward two-

Plate 5.13. Polishing stone.

Plate 5.14. An undifferentiated anvil from Pueblo Alto, Room 103, Layer 2, Level 4. FS #1150.

handed objects that are a little thicker than most active abraders. A variety of sandstones were used but mostly the harder ones (94.3 percent). They averaged 2.2 use surfaces per object. Seven were found in good primary context in habitation structures and on ramada surfaces, which suggests that they were part of the household tool kit.

Kinds and Numbers of Abraders Analyzed

Pueblo Alto had the largest number of abraders collected from Chaco Canyon. A total of 839 was analyzed. At least 200 came from wall-clearing activities. Table MF-5.1 gives the subtype and provenience information. Very few abraders were found in situ or are worthy of discussion.

Room 103 had more abraders than any single provenience, other than the Trash Mound, 107 or 12.7 percent of the total. Unfortunately, most were in wall rubble or had been used in architectural features throughout the room. The same is true for Room 110, where most of the 33 abraders recovered were used in construction or in association with 6 mealing bins.

There is a difference between the number of abraders found in the rooms from the west and those from the northern portions of the site. The western rooms produced 175 abraders, whereas those from the north contributed only 61. This is probably related to greater structural modification within the western rooms.

Pueblo Alto, followed by Una Vida, had the highest percentage of good, hard sandstones (40.4 percent and 39.5 percent, respectively). It also had a fair diversity in cobble materials. Although both Pueblo Alto and 29SJ 627 each had five cobble materials, Pueblo Alto had only 24 cobble abraders whereas 29SJ 627 had 113. It is tempting to suggest that the residents of Pueblo Alto had a greater access to these materials, but this is far from supportable.

Only 29SJ 1360 and Una Vida had higher percentages of extensively modified abraders (14.5 percent), with totals at the smaller sites ranging from 3 to 6 percent. Considering that much of the Una Vida sample consisted of catalogued museum specimens, and that 29SJ 1360 had a pitstructure with all of the household goods left in place, Pueblo Alto had an impressive number of extensively modified tools. Furthermore, a fair portion of that sample was from wall-clearing activities.

Extensive use of abraders was not common at Pueblo Alto. In fact, it shares with 29SJ 629 the distinction of having very low percentages of extensively used abraders, 0.4 percent. Secondary use was also relatively low (31.2 percent), with Una Vida and 29SJ 633 having lower percentages. As these three are the latest sites in the sample, there may have been a decline in reuse of abraders toward the end of the time span.

Site Comparison of Abraders

The best way to evaluate the Pueblo Alto abrader assemblage is to compare the distribution of subtypes at this site with other site samples from the canyon. To do this those sites with sample sizes over 85 were considered, and Una Vida was not used because the sample was heavily biased, consisting primarily of museum specimens (i.e. "goodies"), and not likely to be representative of day-to-day activities and disposal. This left assemblages from seven sites. Simple correlations (Table 5.1) were calculated on a matrix of sites and numbers of abraders within each type (the observed frequencies in Table 5.2). The coefficients are generally high except for polishing stones, which appear to relate to no other form of abrader. All types correlate better with the overall sample size than with any other type. This may suggest that sample size plays a large part in determining distribution of all abrader types except for polishers.

Tables 5.2 through 5.5 give the site distributions and include the expected frequencies for each type (Table 5.2) or subtype (Tables 5.3-5.5). They are arranged in roughly chronological sequence, and the subtypes that are not functionally abraders or those that occurred only infrequently are omitted.

When the main types are considered, Pueblo Alto has more than the expected number of all types except polishers. Table 5.2 illustrates that polisher frequency begins to decrease during the time span represented by 29SJ 629 and continues to decline. The low number of polishers at Pueblo Alto and the other later sites causes all other groups to appear higher. The trend for active abraders is an inverse of that for the polishers suggesting that one form may have replaced the other. When the active abraders and polishers are combined, only Pueblo Alto and 29SJ 629 have fewer active grinding stones than expected.

The passive abraders are under-represented at all sites except Pueblo Alto and 29SJ 629 and grooved at all except Pueblo Alto and 29SJ 628. Anvils are variable and appear to be under-represented at Pueblo Alto. The only general trend observed is the decline of polishers, whereas active abraders increase with time.

Within the active abraders (Table 5.3) some more specific trends occur. Pueblo Alto is the only site to have fewer soft, active abraders than expected whereas hard, active abraders are over-represented. The distribution of these two may be more a function of sampling than a reflection of site activities because a good deal of the Pueblo Alto sample was from wall clearing and remodeling. Hard sandstones may have been selected for use in construction activities.

Faceted abraders occur in small numbers at all sites, even those with no masonry construction. Active lapidary abraders are more interesting. They do not occur (nor do passive lapidary abraders) in the two earliest sites and are over-represented at 29SJ 629, which had considerable evidence of lapidary activities, and at Pueblo Alto. Those from the latter

Table 5.1. Correlation matrix for the abraders. Site samples greater than 85.

Active	1.000					
Passive	0.863	1.000				
Grooved	0.939	0.861	1.000			
Polishers	3.912E-02	-7.774E-02	-5.658E-02	1.000		
Anvils	0.934	0.805	0.824	0.368	1.000	
Total	0.978	0.911	0.920	0.165	0.968	1.000
	Active	Passive	Grooved	Polish	Anvil	Total

Table 5.2. Observed and expected frequencies for Chaco Canyon abraders. Table includes sites with sample size greater than 85.

	ACTIVE		PASSIVE		GROOVED		POLISHERS		ANVILS		ACTIVE + PASSIVE		
SITE	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	TOTAL
29SJ 299	26	43	10	23	0	2	43	13	14	12	69	56	93
29SJ 628	44	66	19	35	7	3	53	20	19	18	97	86	142
29SJ 1360	39	41	10	22	2	2	28	13	10	11	67	54	89
29SJ 629	57	114	128	61	3	5	33	35	27	31	90	150	248
29SJ 627	222	231	80	124	7	11	113	72	78	63	335	302	500
P. Alto	463	387	242	207	24	18	19	120	91	106	482	507	839
29SJ 633	90	60	16	32	2	3	3	19	20	17	93	79	131
TOTAL	941	942	505	505	45	45	292	292	259	259	1,233	1,233	2,042

Table 5.3. Observed and expected frequencies of common active abrader subtypes.

	SOFT UNDIFF.		HARD UNDIFF.		FACETED		LAPIDARY		ANVIL-ABRADER		
SITE	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	Obs.	Exp.	TOTAL
29SJ 299	6	5	16	16	1	1	0	1	1	2	24
29SJ 628	7	8	28	26	1	2	0	1	3	3	39
29SJ 1360	13	7	15	22	4	1	1	1	1	2	34
29SJ 629	19	11	21	35	1	2	5	1	8	3	54
29SJ 627	60	44	119	136	11	9	3	5	14	13	207
P. Alto	58	93	325	289	19	19	12	11	26	28	440
29SJ 633	24	19	58	58	1	4	1	2	4	6	88
TOTAL	187	187	582	582	38	38	22	22	57	57	886

Table 5.4. Observed and expected frequencies for the passive abrader subtypes.

SITE	UNDIFF. Obs.	UNDIFF. Exp.	ANVIL Obs.	ANVIL Exp.	LAPIDARY Obs.	LAPIDARY Exp.	PALLETTE Obs.	PALLETTE Exp.	TOTAL
29SJ 299	3	5	7	2	0	2	0	1	10
29SJ 628	10	10	5	3	0	4	4	1	19
29SJ 1360	2	5	4	2	4	2	0	1	10
29SJ 629	31	69	9	20	83	30	5	9	128
29SJ 627	26	43	30	12	22	19	2	6	80
P. Alto	194	128	15	36	5	55	23	17	237
29SJ 633	5	9	7	2	2	4	2	1	16
TOTAL	271	271	77	77	116	116	36	36	500

Table 5.5. Observed and expected frequencies of polishers.

SITE	UNDIFF. Obs.	UNDIFF. Exp.	POT POLISHER Obs.	POT POLISHER Exp.	LARGE POL. Obs.	LARGE POL. Exp.	TOTAL
29SJ 299	12	25	8	9	22	9	42
29SJ 628	35	30	12	10	4	10	51
29SJ 1360	18	16	6	5	3	5	27
29SJ 629	24	18	4	6	3	6	31
29SJ 627	57	63	27	22	23	22	107
P. Alto	17	11	0	4	2	4	19
29SJ 633	3	2	0	1	0	1	3
TOTAL	166	166	57	57	57	57	280

were relatively few and scattered throughout the site as discards. Anvil abraders are found throughout but are better represented in the later sites.

Pueblo Alto (Table 5.4) is the only site with considerably more than the expected number of undifferentiated, passive abraders. This again may reflect use of large, hard objects in wall and feature construction. Passive lapidary abraders have the most unusual distribution as more than the expected number were found at all three of the Pueblo II small sites and far more at 29SJ 629. This does suggest that lapidary activity was more characteristic of the small sites.

Within the polishers (Table 5.5) Pueblo Alto has fewer than expected pot and large polishers, which accounts for the greater than expected number of undifferentiated polishers.

In summary, it appears that the activities represented by the abraders took place at Pueblo Alto and the small sites. Temporal trends are evident mainly in the distribution of active abraders and polishers. Most significantly, it appears that lapidary activity was predominantly a Pueblo II activity that took place mainly at the small sites.

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Chapter Six

Ornaments and Minerals from Pueblo Alto

Frances Joan Mathien

Introduction

Ornaments and minerals included in this report were recovered during the 1976-1979 excavations at 29SJ 389 (Pueblo Alto) by the National Park Service. A master list of artifacts was compiled from the field specimen (FS) sheets by number; artifacts were collected and analyzed (Table MF-6.1). Methods of analysis have been described by Mathien (1985:19-47); included in the report are definitions of artifact types, problems encountered during analysis, etc. Material, artifact type, and all measurements were recorded in standard format, and tables were prepared. Some materials consisted mainly of bulk that was modified only slightly or not at all (e.g., selenite, hematite, limonite). Such materials were given low priority and not treated to full analysis. Although these were counted and listed by provenience, they are not discussed in detail in this report.

Material Types

Thirty-one different material types were identified during this analysis; included were 13 species of shell. These are listed in Table 6.1. Source areas for shell were determined by Helen DuShane (personal communication, 1979) who identified the shells and their modern habitats with reference to Keen (1971); David Love and A. Helene Warren provided information about locally available minerals (personal communication, 1979). Other mineral locations were obtained by reference to Northrop (1959). These can be summarized as follows.

Aragonite: Possibly a local material. Found in the Kirtland-Fruitland formations within the San Juan Basin.

Argillite: Locally available in Chaco gravels.

Azurite: Found in the mountain ranges peripheral to the San Juan Basin (Zuni, San Juan, and Nacimiento Mountains).

Table 6.1. Material types, 29SJ 389 (Pueblo Alto).

Material Type	n	%	A.D. 920-1020	A.D. 920-1120	A.D. 920-1220	A.D. 1020-1120	A.D. 1020-1220	A.D. 1120-1220	Undated
Aragonite	5	0.15			2 Unm.			3 Unm.	
Argillite	48	1.42	1 Bead 1 Inlay 1 Pend. fr. 2 Unm.		15 Inlay 3 Unm. 1 Zoom.	1 Bead 1 Disk 1 Mod. 1 Other 5 Unm.	1 Bead 3 Unm. 5 Flakes	1 Inlay 4 Mod.	1[a]
Azurite	102	3.02	2 Unm.		1 Ball 1 Other 4 Mod. 45 Unm.	2 Mod. 41 Unm.	3 Unm.	1 Mod. 1 Unm.	1 Unm.
Bone	18	0.53	1 Bead 1 Gm. pc.		1 Bead 1 Ring 1 Whistle	1 Bead 1 Bead bl. 4 Gm. pc.		5 Beads 1 Pend. 1 Orn.	
Calcite	142	4.20	26 Beads 3 Unm.		12 Beads 2 Gm. pc. 2 Inlay 37 Mod. 1 Other 2 Pend. bl. 1 Unm.	31 Beads 2 Mod. 1 Inlay	4 Beads 3 Mod. 1 Gm. pc.	9 Mod. 2 Pend. bl.	1 Mod. 1 Pend. bl. 1 Bead
Ceramic	2	0.06	1 Pend.			1 Ball			
Chert, green	1	0.03							1 Unm.
Coal	1	0.03						1 Unm.	
Copper	2	0.06			1 Bell	1 Bell			
Galena	3	0.09	1 Mod. 1 Unm.				1 Mod.		
Goethite	1	0.03				1 Zoom.			
Gypsite	1,349	39.93	3 Bead 89 Unm. 3 Pend.		1 Mod. 26 Unm.	1 Mod. 1218 Unm. 1 Bead 4 Unk.		3 Mod.	
Gypsum	6	0.18			5 Unm.				1 Unm.
Hematite	135	4.00	3 Mod. 11 Unm. 1 Unk.	1 Mod.	8 Mod. 12 Unm.	31 Deb. 5 Mod. 54 Unm.	2 Unm.	6 Mod. 1 Unm.	
Jet	1	0.03			1 Unk.				
Lignite	60	1.78	13 Unm. 1 Unk.		6 Inlay 1 Mod. 1 Pend. bl. 21 Unm. 1 Unid.	1 Mod. 5 Unm. 2 Zoom.	1 Pend. bl. 2 Unm.	2 Mod. 3 Unm.	
Limonite	135	4.00	10 Mod. 26 Unm.	1 Unm.	7 Mod. 1 Other 11 Unm.	1 Gm. pc. 20 Mod. 49 Unm.	5 Unm.	3 Mod. 1 Unm.	
Malachite	155	4.59			12 Mod. 3 Unm. 1 Unk.	2 Unm.	1 Unm.	134 Deb. 1 Mod. 1 Unm.	
Mica-muscovite	47	1.39			1 Mod. 41 Unm.	2 Unm.		1 Unm.	2 Unm.
Mineral, unid.	10	0.30			2 Unk.	8 Unk.			
Opal	1	0.03			1 Zoom.				

[a]Percentages rounded to nearest hundredth.

Table 6.1. (concluded)

Material Type	n	%	A.D. 920-1020	A.D. 920-1120	A.D. 920-1220	A.D. 1020-1120	A.D. 1020-1220	A.D. 1120-1220	Undated
Other fossil	1	0.15			5 Unk.				
Quartz crystal	1	0.03	1 Pend.						
Quartzite	9	0.27	9 Unm.						
Sandstone	2	0.06			1 Other	1 Unm.			
Selenite	569	16.84	6 Mod. 51 Unm. 1 Zoom. 8 Unk.	3 Unm.	4 Mod. 130 Unm. 1 Zoom. 1 Unk.	1 Bead 13 Mod. 2 Pend. 182 Unm. 1 Zoom. 1 Unk.	132 Unm.	17 Mod. 13 Unm. 1 Pend. 1 Pend. bl.	
Serpentine	1	0.03			1 Ring				
Shale	154	4.56	91 Beads 1 Inlay 1 Unm.	4 Beads	10 Beads 1 Pend.	34 Beads 1 Other 1 Ring	2 Beads	1 Unm. 1 Mod. 1 Pend. 1 Other	4 Beads
Shark's teeth	12	0.36	10		1	1			
Shell:									
Argopectin c.	1	0.03	1 Unm.						
Chama echinata	19	0.56	2 Beads 1 Pend.		1 Bead 1 Br. fr. 12 Inlay	1 Pend.		1 Pend.	
Choro. pallio.	1	0.03				1 Unm.			
Fos. shell imp.	9	0.27	1		6	2			
FW clam	2	0.06	1 Unid. 1 Mod.						
Glycymeris g.	64	1.89	4 Beads 19 Br. fr.		2 Beads 25 Br. fr. 1 Pend.	7 Br. fr. 1 Br. fr.	1 Br. fr.	2 Br. fr. 2 Beads	
Haliotus cr.	3	0.09			2 Other		1 Other		
Lymnaea bul. L.	1	0.03			1 Unm.				
Oliva incr.	1	0.03			1 Zoom.				
Olivella dama	21	0.62			4 Beads 1 Pend. bl.	12 Beads 1 Unid.	2 Beads	1 Bead	
Spondylus c.	1	0.03	1 Bead						
Spondylus p.	1	0.03			1 Other				
Unidentified	1	0.03			1 Bead				
Turquoise	276	8.17	3 Beads 17 Deb. 36 Mod. 28 Unm.		4 Beads 3 Bead bl. 118 Inlay 7 Mod. 6 Deb. 2 Pend. 4 Pend. bl. 3 Unm.	6 Beads 5 Deb. 4 Inlay 10 Mod. 4 Pend. 3 Pend. bl. 3 Unm.	1 Debris 1 Unm.	1 Inlay 1 Pend. 1 Unm.	3 Deb. 1 Mod. 1 Unm.
Totals	3,377	100.05	495	9	656	1797	172	230	18

Bone: Probably from available fauna used by inhabitants for other purposes.

Calcite: Locally available in Chaco Canyon. "Travertine form is widespread as deposits in mineral spring waters." (Northrop 1959)

Ceramic: Reused sherd.

Chert, green. Locally available and also found in Four Corners area and Red Mesa Valley.

Coal: Locally available in cliff deposits, especially in softer forms. See lignite.

Copper: Imported from areas external to the San Juan Basin. Although there are numerous copper deposits in New Mexico and Arizona, finished copper bells were imported from Mexico.

Galena: Nearest source is the Grants District, McKinley County.

Goethite: Locally available in Chaco area.

Gypsite: Locally available in Chaco area.

Gypsum: Locally available in Chaco Canyon.

Hematite: Found in the Cliff House formation at Chaco.

Jet: Probably local. However, the exact mineral utilized in some artifacts could not be determined without employing some type of destructive technique. Coal, lignite, goethite and some varieties of black shale are available in Chaco Canyon.

Lignite: Locally available in seams in Chaco cliffs.

Limonite: Found in the Cliff House formation at Chaco Canyon.

Malachite: Small amounts are found in the Haystack area, Grants District of McKinley County. Other deposits in mountains surrounding the San Juan Basin (e.g. Zuni, San Juan, and Nacimiento mountains).

Mica-muscovite: Found in the Grants District of McKinley County.

Mineral: Field specimen not found in the laboratory; identity remains unknown.

Opal: Locally available in Chaco area.

Other fossil: Unknown.

Quartz crystal: Probably imported from outside the San Juan Basin.

Quartzite: Found in local gravels.

Sandstone: Locally available.

Selenite: Locally available with especially good crystals in Chaco Canyon.

Serpentine: Found within the San Juan Basin, near Buell Park in Apache County, Arizona.

Shale: Menefee shale is part of the local formation; baked shales are found in the Kirtland-Fruitland formation. Mancos shale is found around the peripheries of the San Juan Basin.

Shark's teeth: Local fossilized material.

Shell: Habitat descriptions taken from Keen (1971). Scientific names of species include discoverer and year written according to standard format of malachologists; therefore, the reader is warned not to interpret these as references.

Argopectin circularis (Sowerby, 1935): Pelecypoda (bivalves or clams) found from Cedros Island, Baja California Norte, throughout the Gulf of California and south to Peru. Common on sandy mud flats.

Chama echinata Broderip, 1835: Pelecypoda found from southern Gulf of California to Panama. Mazatlan, Sinaloa, is the northern point where it can easily be found.

Choromytilus palliopunctatus (Carpenter, 1857): Pelecypoda confined to exposed-coast intertidal areas where mussels live fastened to rocks; from Magdalena Bay, Baja California to Panama.

Fossil shell impressions: Not identified, but probably remnants of older local species.

Freshwater clam, possibly Rabdotus Schiedeanus: Year around water is available in San Juan River to the north and the Rio Grande to the west. However, exact source is not known.

Glycymeris gigantea (Reeve, 1843): Pelecypoda found from Bahia Magdalena, Baja California Sur to Acapulco and in the Gulf of California north to approximately Mulege, Baja California Sur. On the west coast of Mexico only beach valves are found north of Mazatlan, Sinaloa, Mexico.

Haliotus cracherodii Leach, 1817: Gastropoda (snails) found from Coos Bay, Oregon to Cabo San Lucas, Baja California Sur, Mexico. This species does not occur in Panamic province except in the transitions zone, Cedros Island to Cabo San Lucas, although one small species is endemic to

the Galapagos Islands, Ecuador. Common on rocks at low tide. Does not occur in the Gulf of California.

Lymnaea bulemoides Lea Keep, 1935: Gastropoda found in freshwater. Can survive in slow moving water.

Oliva incrassata [Lightfoot, 1786]: Gastropoda found on sand beaches throughout the Gulf of California south to Peru.

Olivella dama (Wood, 1828, ex Mawe MS): Gastropoda found from head of the Gulf of California, Mexico south to Panama.

Spondylus calicifer Carpenter, 1857: Pelecypoda found from Gulf of California, Mexico to Ecuador.

Spondylus princeps unicolor Sowerby, 1947: Pelecypoda found from Cedros Island, Baja California Norte and from Concepcion Bay, Gulf of California to Jalisco, Mexico. Species taken only by divers, but not at great depths.

Unidentified.

Turquoise: Imported from area(s) external to the San Juan Basin. Nearest source is approximately 200 km distant, but other areas are known to have been worked prehistorically and could have been utilized. Exact source remains unknown.

The breakdown of artifacts from Pueblo Alto into discrete time periods (Table 6.2) reveals that there are sufficient numbers in the three subdivisions of the Bonito phase to attempt an overall comparison.

A total of 495 artifacts (14.7 percent of all artifacts from Pueblo Alto) was assigned to the Early Bonito phase (A.D. 920-1020). Of these, 375 (75.6 percent) were available locally, four (0.8 percent) were available within the remainder of the San Juan Basin, and 116 (23.4 percent) were imported from areas external to the basin. The most abundant of the 22 material types were gypsite (95 pieces or 19.2 percent of the material from this period, available locally), shale (93 or 18.6 percent, available locally), turquoise (84 or 16.9 percent, imported from outside the basin), and selenite (66 or 13.3 percent, available locally).

A total of 1,796 artifacts, including 22 material types, was assigned to the Classic Bonito phase (A.D. 1020-1120). Of these 1,681 (93.6 percent) were locally available, 47 (2.6 percent) were from the basin, and 58 (3.2 percent) were imported from areas external to the San Juan Basin. The most abundant material was gypsite (1,224 or 68.2 percent), followed by selenite (200 or 11.1 percent) and hematite (90 or 5.0 percent).

A total of 230 artifacts was recovered from Late Bonito proveniences (A.D. 1120-1220). In this period, the locally available artifact materials totaled 82 (or 35.7 percent), whereas those from the basin were 139

Table 6.2. Artifact classes, 29SJ 389 (Pueblo Alto).

Artifact Class	Total n	A.D. 920-1020	A.D. 920-1120	A.D. 920-1220	A.D. 1020-1120	A.D. 1020-1220	A.D. 1120-1220	Undated
Balls	2			1 Azurite	1 Ceramic			
Beads	280	1 Argillite 1 Bone 26 Calcite 3 Gypsite 91 Shale 2 *Chama* 4 *Glycymeris* 1 *Spondylus* 3 Turquoise	4 Shale	1 Bone 12 Calcite 10 Shale 1 *Chama* 2 *Glycymeria* 4 *Olivella* 1 Unid. shell 4 Turquoise	1 Argillite 1 Bone 31 Calcite 1 Selenite 34 Shale 12 *Olivella* 1 Gypsite 6 Turquoise	1 Argillite 4 Calcite 2 Shale 2 *Olivella*	5 Bone 2 *Glycymeris* 1 *Olivella*	4 Shale 1 Calcite
Bead blanks	4			3 Turquoise	1 Bone/fleaher			
Bells	2			1 Copper	1 Copper			
Bracelet fr/pend.	55	19 *Glycymeris*		1 *Chama* 25 *Glycymeris*	7 *Glycymeris*	1 *Glycymeris*	2 *Glycymeris*	
Disks	1				1 Argillite			
Effigies/Zoom.	9	1 Selenite		1 Argillite 1 Opal 1 Selenite 1 *Oliva inc.*	1 Goethite 2 Lignite 1 Selenite			
Gaming pieces	9	1 Bone		2 Calcite	3 Bone 1 Limonite	1 Calcite	1 Bone	
Inlay	162	1 Argillite 1 Shale		15 Argillite 2 Calcite 6 Lignite 12 *Chama* 118 Turquoise	4 Turquoiae 1 Calcite		1 Argillite 1 Turquoiae	
Ornaments, other	11			1 Calcite 1 Limonite 1 Limonite 1 Sandstone 3 *Haliotus* 1 *Spondylus p.*	1 Argillite 1 Shale	1 *Haliotus*	1 Bone	
unid.	2	1 FW clam			1 *Olivella*			
Pendants	22	1 Ceramic 1 Quartz cry. 1 *Chama* 3 Gypsite		2 Turquoise 1 Shale 1 *Glycymeris*	2 Selenite 1 *Chama* 4 Turquoise		1 Bone 1 Selenite 1 Shale 1 *Chama* 1 Turquoise	
Pendant blanks	17	1 Argillite		2 Calcite 1 Lignite 1 *Olivella* 4 Turquoise	3 Turquoise	1 Lignite	2 Calcite 1 Selenite	1 Calcite
Rings	3			1 Bone 1 Serpentine	1 Shale			
Whiatle	1			1 Bone				
Totala	580	163	4	247	125	13	22	6

(60.4 percent) with 9 (3.9 percent) imported from areas external to the basin. This shows a change from the previous two discrete periods wherein most of the materials were locally available in the canyon. Whether this is an accurate reflection of what was occurring has not been determined. There are other artifacts in broader time segments (A.D. 920-1120, 920-1220, 1020-1220) that could not be more discretely assigned chronologically and might affect the trend among the three Bonito phases.

If we assume that material from this site is an accurate representation of occurrences, the Early Bonito phase (A.D. 920-1020) represents a higher use of imports from other areas outside the San Juan Basin than do either the Classic or Late Bonito phases. Comparison with Una Vida, the other townsite partially excavated during this project, is difficult because the amount of material recovered and the rooms at that site contain biases that cannot be corrected. Indications suggest a similar pattern, however.

It is possible to compare the percentage of ornaments made from materials from external sources rather than all materials from Pueblo Alto with those from Una Vida:

Ornaments from External Sources (%)

Site	A.D. 920-1020	A.D. 1020-1120	A.D. 1120-1220
Pueblo Alto	19.6	31.2	38.1
Una Vida	66.7	76.9	62.5

At Pueblo Alto the number of ornaments made from materials from outside the basin is generally low. At Una Vida, the higher proportions of ornaments were made from imported materials. This may be due to different collection strategies used by site excavators, or it may reflect differences in site function among greathouses and their inhabitants.

Although many of the material types noted for Pueblo Alto were found at other, earlier sites, and most of the material types were present throughout the occupation of Pueblo Alto, a few were noted to appear during discrete time periods. The appearance of copper after A.D. 1020 is consistent with Judd's (1954) statement that it is found in Chacoan sites at about A.D. 1050 or later. The quartz crystal and two of the shell species (Argopectin circularis and Spondylus calcifer) are dated between A.D. 920 and 1020, a time when numerous new materials from the San Juan Basin and western marine coast shells began to appear in Chaco Canyon sites. A third shell species, Choromytilus palliopunctatus, found only in the A.D. 1020-1120 period, was represented by only two other shells of this species among the entire collection from all sites. These, from Kin Kletso, Room 5 fill, are also dated post-A.D. 1020. Whether or not evidence from small samples is valid remains to be seen, but it does suggest that some new shell types did become part of the trade network at the later end of the occupational sequence as well as during the A.D. 920-1020 period.

Artifact Classes

A total of 579 artifacts were assigned to 14 ornament classes. This represents 17 percent of all the minerals and shells recovered from this site. Table 6.3 lists these classes by time period and material type. Beads were most frequently recovered (48.3 percent of the 579 ornaments), followed by inlay (28.4 percent) and bracelet pieces (9.5 percent). These three classes represent 86.2 percent of all the ornament classes recovered at Pueblo Alto. More detailed discussion of these discrete classes follows.

Balls

One azurite ball (FS 6779) was recovered in Room 143, Floor 1, fill. Although a sphere, it is not perfectly round as it measures 0.81, 0.79, and 0.78 cm in diameter depending on the direction of measurement. A line was carved around it (Plate 6.1). A ceramic ball (FS 4771) found in the Trash Mound may represent a bell clapper.

Beads

Data in Table 6.3 show that shale was the most commonly used material for beads recovered from this site; 145 beads (or 52.1 percent of the beads) were made from shale, and these are found during all time periods. The second most common material is calcite (73 or 26.3 percent), followed by *Olivella dama* (20 or 14.0 percent), and turquoise (13 or 4.7 percent). Other materials contribute the remaining 3.3 percent. Because there were sufficient numbers of beads of different material types from different time periods, an evaluation of changes in bead size through time is included below.

Three argillite beads vary in size; those from earlier proveniences are somewhat smaller than the later dated ones (Table 6.4). All three beads are discoidal and had been ground on the two flat surfaces and around the edges. All were drilled from two sides as evidenced by biconical perforations.

Bone beads vary in shape. One is discoidal (FS 6615) and had been ground on two sides and around the edge. A perforation measuring 0.19 cm had been drilled from two sides. The remaining bone beads are tubular in shape; the long bones had been modified by grinding at one or both ends. Polish is present on all but one. Two have evidence of cut marks at one end. Nancy Akins of the Chaco Center staff identified species when possible; these were generally classified as bird bones (Table 6.5).

Calcite beads are all discoidal in shape (Table MF-6.2). Two provenience groups provide the best data for comparative purposes.

Table 6.3. Beads by material type and time, 29SJ 389 (Pueblo Alto).

Material Type	Total n	A.D. 920-1020	A.D. 920-1120	A.D. 920-1220	A.D. 1020-1120	A.D. 1020-1220	A.D. 1120-1220	Undated
Argillite	3	1	-	-	1	1	-	-
Bone	8	1	-	1	1	-	5	-
Calcite	73	26	-	12	31	4	-	-
Gypsite	4	3	-	-	1	-	-	-
Selenite	1	-	-	-	1	-	-	-
Shale	145	91	4	10	34	2	-	4
Shell								
Chama echinata	3	2	-	1	-	-	-	-
Glycymeris gig.	8	4	-	2	-	-	2	-
Olivella dama	20	-	-	4	13	2	1	-
Spondylus calc.	1	1	-	-	-	-	-	-
Unid. shell	1	-	-	1	-	-	-	-
Turquoise	13	3	-	4	6	-	-	-
Totals	280	132	4	35	88	9	8	4

Plate 6.1. Azurite ball from Pueblo Alto: FS 6779 from Room 143.

Plate 6.2. Calcite, shale, and Chama echinata beads from Plaza 1 of Pueblo Alto: FS 6615.

Table 6.4. Argillite beads, 29SJ 389 (Pueblo Alto).

Time Period (A.D.)	FS No.	Provenience	MEASUREMENTS (cm) Diam. 1	Diam. 2	Thick.	Perf.	Comments
920–1020	4354	Pl. 1, Gr. 30, OP 1	0.32	0.32	0.08	0.09	Ground all sides, edges. Drilled 2 sides.
1020–1120	1290	Rm. 103, Fl. 3, fill	0.40	0.40	0.16	0.19	Ground all sides, edges. Drilled 2 sides. Some polish.
1020–1220	6510	Kiva 10, TT 1, Lv 26	0.73	0.73	0.39	0.26	Ground all sides, edges. Drilled 2 sides. Striations.

Table 6.5. Bone beads, 29SJ 389 (Pueblo Alto).

Time Period (A.D.)	FS No.	Provenience	MEASUREMENTS (cm) Length	Diam. 1	Diam. 2	Comments
920–1020	6615	Pl. 1, Gr. 8, Fl. 9, Lv 15	0.41	0.41	0.25	Disk bead, with 0.19 cm perforation. Ground all sides and edges. Polish. Drilled 2 sides.
920–1020	923	Pl. 1, Fea. 1, Rm. 3, Ly 3	4.60	0.63	0.53	Meleagris radius. Ground 2 ends, slight polish, few striations.
1020–1120	4571	TM 225, Lv 12	5.24	1.10	1.07	Meleagris. Ground 1 end, 2nd end shows cut marks and is irregular with some wear, which eliminated rough edges. Striations on long bone surfaces.
1120–1220	6508	Kiva 10, TT 1, Lv 23	3.03	1.15	0.98	Unidentified species. Three pieces glued back together. Ground 2 ends.
	6509	Kiva 10, TT 1, Lv 24	3.15			Aves long bone. Ground 2 ends, polished, striations. Fragment only.
			3.46			Aves long bone. Ground 1 end, other rough. Polish, striations. Fragment.
	6517	Kiva 10, TT 1, Lv 25	2.58	1.06	0.87	Buteo sp. Ground 2 ends, polish, striations. Two small cuts on one end.
			5.66	0.96	0.67	Aves, probably Buteo sp. Ground 2 ends (part missing). Slight polish.

In A.D. 920-1020 period, Plaza 1, Grid 8, Layer 15, a total of 23 calcite beads (FS 6613 and FS 6615) as well as shale beads were recovered from a test area, which represents trash fill beneath the floors of the plaza. Plate 6.2 illustrates the calcite, shale, and Chama echinata beads collected as FS 6615. The average diameter of these calcite beads is 0.35 cm, average thickness 0.14 cm, and average perforation 0.18 cm. The remaining three calcite beads from this discrete time period ranged from 0.33 to 0.43 cm in diameter. FS 6716 (Plaza Grid 8, level 4) and FS 4354 (Plaza Grid 30, OP 1) are larger than the 23 beads from layer 15 by approximately two or more standard deviations, but perforation sizes were similar (Table MF-6.2). Because these are from areas above the lowest floors of the plaza and were made at a somewhat later time than the 23 beads, this may indicate a trend toward larger bead size through time.

For A.D. 1020-1120, evidence comes from Room 103: If one assumes that a single family lived here and remodeled the floors on several occasions, it is possible to describe the nine calcite beads (FS 1144, 1147, 1129, 1251, and 1329) as a single group. However, those from Floor 1 (FS 1144 and 1147) are somewhat smaller than the material from Floors 2 and 4 (Table MF-6.2). This trend contrasts with the one described above for Plaza 1, Grid 8. What might be suggested is that a worker does not consistently make all beads of one material the same size, but that size varies because of other factors such as the purpose of the ornament being made and/or the size of the available raw material.

Based on the analysis of all calcite beads found at Pueblo Alto, it is possible to suggest that some of the variability in the diameter size may be due to change through time. Table 6.6 provides some basic statistics, divided by time periods, on all calcite beads.

Two of these time periods contained a total of 26 and 30 calcite beads each: A.D. 920-1020 and A.D. 1020-1120. The student's t test was calculated to compare the mean diameters for beads from these two periods, and the null hypothesis was rejected. Therefore, it is suggested that there may be some trend toward increased size of calcite beads through time.

Data on four gypsite and one selenite bead are presented in Table 6.7. Two of these beads (FS 585) and possibly all of the gypsite were originally selenite, as the gypsite is too soft to be worked into beads. FS 585 is very soft and disintegrates somewhat when touched. Burned selenite becomes soft, but burned calcite is sturdier. Shell bracelet fragments (calcium carbonate) are also soft and powdery at times; therefore, it is expected that calcite (also calcium carbonate) would react to natural processes during depositional history in a similar manner. Very few other beads of these material types have been found in other Chacoan sites, and it is suggested that these materials were very infrequently selected for the manufacture of ornaments. Plate 6.3 illustrates beads and pendants of gypsite from Pueblo Alto.

Table 6.6. Basic statistics on calcite beads, 29SJ 389 (Pueblo Alto).

Time Period (A.D.)	920-1020	920-1220	1020-1120	1020-1220
Total Number	26	12	30	4
Mean diameter (cm)	0.35	0.55	0.46	0.45
Standard deviation	0.0235	0.6934	0.0561	0.0912
Variance	0.00053	0.0044	0.0030	0.00625

Comparison of Periods A.D. 920-1020 and A.D. 1020-1120:

Student's t test:
Alpha at .025 = 1.960 for 2-tailed test and 95% confidence.
t = -9.46.

Conclusion: Diameter is different for these two samples since 9.46 is larger than 1.960; this suggests that the average diameter of calcite beads is larger during the later period.

Table 6.7. Other beads, 29SJ 389 (Pueblo Alto).

Material/ Time Period (A.D.)	FS No.	Provenience	MEASUREMENTS (cm) Diam. 1	Diam. 2	Thick.	Perf.	Comments
Gypsite:		(All are soft and probably are burned calcite)					
920-1020	4633	TM 70, SC 1, Ly 3	0.69	0.62	0.36	0.22	Ground all sides, edges. Drilled 2 sides.
	585	Kiva 3, WC, probably	0.42	0.42	0.16	0.19	Ground all sides, edges. Drilled 2 sides.
		pilaster base	0.43	-	0.13	0.19	Ground all sides, edges.
1020-1120	4370	TM, tourists	0.62	0.62	0.28	0.32	Ground all sides, edges. Drilled 2 sides.
Selenite							
1020-1120	6550	North trench 1	0.41	0.40	0.10	0.20	Ground all sides, edges. Drilled 2 sides.

Plate 6.3. Gypsite beads and pendants from Pueblo Alto: FS 4663 (Trash Mound) and FS 585 (Kiva 3).

Plate 6.4. Shell ornaments from Pueblo Alto: FS 2198 (Olivella dama bead); FS 5348 (Chama echinata bead); FS 6506 (Olivella dama bead); FS 6073, FS 6504 (Chama echinata pendants); and FS 6271 (Glycymeris gigantea pendant).

Shale beads were predominant at this site. The majority were black; some were gray. Although shale beads were found in greatest numbers between A.D. 920-1020, they occurred during all time periods (Table MF-6.3). When material from three discrete proveniences with sufficient beads was examined, certain trends were suggested.

For A.D. 920-1020, evidence comes from FS 6615, Plaza 1, Grid 8, layer 15 (Plate 6.2). Forty-seven black shale beads had an average diameter of 0.27 cm with a range from 0.22-0.31 cm. When all material from beneath the plaza floor was considered (FS 6613, 6615, 6616, 6617, 6618, and 6619), 62 black beads had an average diameter of 0.29 cm with a range from 0.22-0.66 cm.

For A.D. 920-1020 Room 142, below Floor 2, contained beads attributed to the early 1000s (FS 2914). Eighteen beads (6 black and 12 gray) had an average diameter of 0.41 cm with a range from 0.39-0.48 cm.

For A.D. 1020-1120 Trash Mound materials recovered by tourists (FS 4732) contained 13 beads (2 black and 8 gray) with an average diameter of 0.40 cm with a range from 0.24-0.50 cm. These beads are assigned to the late 1000s.

Data from these three samples suggested that diameter sizes of shale beads increased through time even though the range of bead sizes from the earliest time period overlapped with the size range for the later time periods. To test this hypothesis, all beads were grouped by time period (Table 6.8). A quick glance at the mean diameter sizes for all beads suggested a larger diameter during the later periods but a slight decrease between A.D. 1020-1120 and A.D. 1020-1220. As illustrated in Table 6.8, the increase between A.D. 920-1020 and A.D. 1020-1120, however, could not be substantiated statistically. A t test with alpha at .025 should have had a student's t of 1.96 or greater if there were significant differences between the early and late 1000s; however, the result of t = 1 suggests no such differences exist. When two other samples (FS 6615 from Plaza 1, Grid 8, A.D. 920-1020) and FS 2914 (Room 142, below Floor 2, early 1000s) were compared, a t value of 12.2 suggested there were major differences in average bead diameters. Because it is not possible to control for time between these two proveniences in a more definitive manner, this may indicate that there is a difference in size that is due to factors other than trends through time. It is possible to suggest that different workers may make beads of different sizes, depending on the use of the beads, or perhaps, the size of the raw material available at the time of manufacture.

Five different types of shell were used for beads; details are summarized in Table 6.9. Because there are very few beads of any particular species (except Olivella dama), no major inferences can be made. The Olivella dama beads are of various sizes; this is a factor of the actual shell size rather than manufacturing techniques. Some of these beads are ground on one and/or both ends, whereas others were used with little or no enlargement of the holes at the upper end of the shell. There seems to be no patterning in this process. One Olivella dama bead (FS 2198), and a

Table 6.8. Basic statistics on shale beads, 29SJ 389 (Pueblo Alto).

Time Period (A.D.)	920-1020	920-1120	920-1220	1020-1120	1020-1220	Undated
Total Number	90	4	10	34	2	4
Mean diameter (cm)	0.330	0.485	0.444	0.45235	0.43	0.33
Standard deviation	0.08432	0.03696	0.09686	0.12502	0.2687	0.0424
Variance	0.007032	0.00102	0.0084	0.01517	0.0361	0.00135

Test 1: Student's t comparing A.D. 920-1020 with A.D. 1020-1120.

Alpha at .025 = 1.960 for a 2-tailed test and 95% confidence.
t = 0.13449.

Conclusion: Null hypothesis cannot be rejected; therefore, samples are not necessarily different with regard to average bead diameter between A.D. 920-1020 and A.D. 1020-1120.

Test 2: Student's t comparing early and late 1000s.

Alpha at .025 = 1.960 for a 2-tailed test and 95% confidence.
t = 1.

Conclusion: Null hypothesis cannot be rejected; therefore, samples are not necessarily different with regard to average bead diameter between early and late 1000s.

Test 3: Student's t comparing FS 6615 (A.D. 920-1020) and FS 2914 (early 1000s).

Alpha at .025 = 1.960 for a 2-tailed test and 95% confidence.
t = 12.22.

Conclusion: Null hypothesis is rejected; there is a difference between samples from approximately the same time period.

Table 6.9. Shell beads, 29SJ 389 (Pueblo Alto).

Time Period (A.D.)	FS No.	Provenience	MEASUREMENTS (cm) Diam. 1	Diam. 2	Thick.	Perf.	Comments
Chama echinata							
920-1020	6608	Pl. 1, Gr. 8, Fl. 9, Ly 15/16	0.33	0.22	0.13	0.17	Ground all sides, edges. Drilled 2.
	6615	Pl. 1, Gr. 8, Fl. 9, Ly 15	0.52	0.54	0.19	0.24	Ground all sides, edges. Drilled 1.
920-1220	5348	Kiva 15, Ly 7	0.90	0.77	0.10	0.25	Ground all sides, edges. Drilled 1, polished.
Glycymeris gigantea							
920-1020	6363	Rm. 50, Subfloor 1	0.35	0.33	0.14	0.19	Ground all sides, edges. Drilled 2.
	6605	Pl. 1, Gr. 8, Fl. 8, Ly 14	0.43	0.43	0.21	0.22	Ground all sides, edges. Drilled 2, polished.
	6606	Pl. 1, Gr. 8, Fl. 8, Ly 14	0.30	0.30	0.16	0.18	Ground all sides, edges. Drilled 2, polished.
			0.32	0.32	0.13	0.20	Ground all sides, edges. Drilled 2, polished.
920-1220	4287	Pl. 1, West of Rm. 177/183	0.43	0.43	0.17	0.22	Ground all sides, edges. Drilled 1.
	665	Unknown, tourists	0.43	0.43	0.12	0.19	Ground all sides, edges. Drilled 2.
1120-1220	569	Kiva 9, WC	0.49	0.48	0.12	0.24	Ground all sides, edges. Drilled 2.
	994	Pl. Fea. 1, Rm. 3, FP 2	0.36	0.36	0.15	0.20	Ground all sides, edges. Drilled 2.
Olivella dama							
920-1220	2198	Rm. 145, Ly 7, Lv 7	0.80	0.75	0.18	0.20	Ground all sides, edges. Drilled 2. Dish shaped.
	2199	Rm. 145, Ly 7, Lv 7	0.60	0.56	0.49	-	Drilled 2, polished.
	544	Rm. 229, wall facing	1.41	0.67	0.62	0.24	Drilled 1.
	664	Unknown, tourists	1.13	0.62	-	-	
1020-1120	5529	Rm. 110, Ly 6, fill	0.89	0.61	0.52		Ground 2 ends. Broken 1/4.
	1521	Rm. 110, Fl. 1, mealing bin	1.17	0.55	0.51	0.24	Drilled 1, polished.
	1626	Rm. 110, WN 4	1.28	0.62	0.54	0.16	Drilled 1, polished, carved 1.
	3676	OS 5, test, stairs	0.53	0.52	0.52	-	Ground 2 ends, polished.
	4643	TM, TT, profile clearing	1.47	0.69	0.65	0.22	Ground 1 end, drilled 1.
			1.14	0.52	0.48	0.20	Ground 1 end, drilled 1.
			Unidentified fragment also present.				
	4734	TM 154, Ly 41-35	0.97	0.54	0.54	-	Ground 1 end.
	4642	TM 155/183/211	1.49	0.70	0.62	0.20	Drilled 1, polished.
			1.36	0.65	0.57	0.19	Drilled 1, polished.
1020-1120	4618	TM 183, Lv 8	1.18	0.78	0.72		
	4586	TM 267, Lv 13	1.39	0.78	0.71		
	4558	TM 323, Lv 13	1.64	0.78	0.68	0.23	Drilled 1, striations.
1020-1220	6733	Pl. 1, Gr. 9, Ly 4	1.23	0.60	0.53	0.21	Ground 1 end, drilled 1.
	981	Pl. Fea. 1, Rm. 3, OP 2	0.57	0.52	0.47	-	Ground 1 end.
1120-1220	6506	Kiva 10, TT 1, Lv 21	0.62	0.59	0.58	-	Ground 2 ends, polished, striations.
Spondylus calcifer							
920-1020	4355	Pl. 1, Gr. 30, OP 1	0.40	0.31	0.30	0.21	Ground all sides, edges. Drilled 2.
Unidentified shell							
920-1220	672	OS 13, fill	0.59	0.58	0.20	0.20	Ground all sides, edges. Drilled 2.

Chama echinata bead (FS 5348) were drastically modified into disc-shaped pieces more similar in form to the discoidal beads made from other materials, and one Olivella dama bead (FS 6506), which was ground from both ends, illustrates the rare forms of shell beads at this site (Plate 6.4).

The 13 turquoise beads from this site are also a very small sample from which to make inferences, as they are assigned to 3 different time periods (Table MF-6.4). Only three beads (each one from a different provenience) are assigned to the A.D. 920-1020 period, and six are from the A.D. 1020-1120 period and come from four discrete proveniences. When beads from these two periods are compared overall, the average bead diameters are 0.276 cm (A.D. 920-1020) and 0.528 cm (A.D. 1020-1120), which suggests that turquoise beads do increase through time as did the calcite beads. The student's t test, however, did not confirm this impression; the result of the test (t = 0.0348) is smaller than 0.415 at a = .10, with 7 degrees of freedom. There were no statistical differences. The turquoise artifact (FS 5457) from Room 103 that was classified as a bead because of its center perforation (Plate 6.5) was the largest found. Most disc beads are much smaller.

In summary, there seem to be some differences in bead sizes at Pueblo Alto. Although data on argillite, shale, and turquoise beads did not statistically confirm a trend toward increased size through time, calcite bead data suggest this hypothesis. However, variation in manufacturing and material availability may account for this phenomenon.

Bead blanks

Table 6.10 presents data on bead blanks. The three turquoise ones could not be assigned to a discrete time period. The design on the bone flesher (FS 4549) suggests that it may have been reused or in the process of reuse to prepare bead blanks for manufacture (Plate 6.6). However, the neat arrangement of two rows of circular, bead-sized incisions may just as easily represent a design on the original tool. It is the only example of possible bone bead blanks found during the recent Chaco Canyon excavations.

Bells

Two copper bells were recovered from Pueblo Alto (Plate 6.7). The first, FS 35, was found in Plaza 1 (fill of probable kiva) and dates to A.D. 1020-1120. The larger of the two bells, it measures 2.07 cm in length, and 1.12 cm and 1.07 cm in diameter. However, it suffers from the ravages of time and no longer retains its original shape. Based on its present form, it is classified as a type IIA1a (DiPeso 1974, Vol. 7:510) or type IC1a (Pendergast 1962), and is similar to Judd's (1954:Figure 28) c or e style. The loop was not separate from the body and no pellet remained.

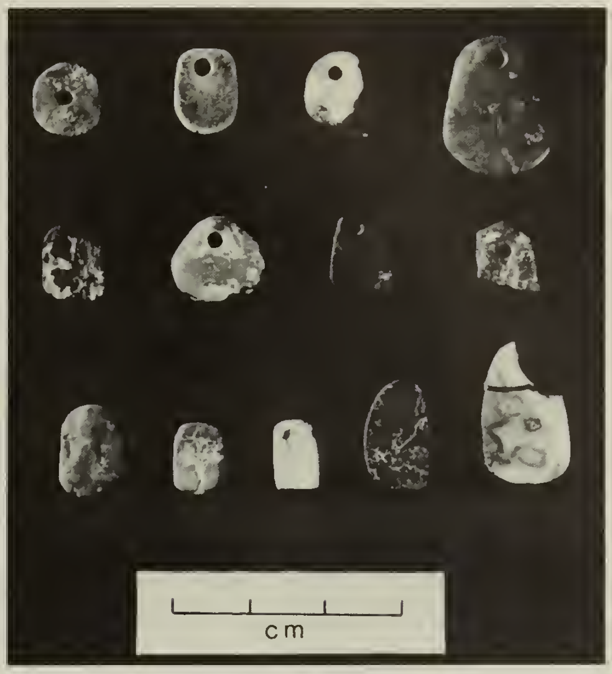

Plate 6.5. Turquoise ornaments from Pueblo Alto: FS 5457 (bead); FS 4245, FS 6007, FS 1206, FS 7092, FS 4733, FS 4790, FS 4600 (pendant blanks).

Plate 6.6. Bone flesher/bead blank from Pueblo Alto: FS 4594 from Grid 239 of the Trash Mound.

Plate 6.7. Copper bells from Pueblo Alto: FS 35 from the fill of Plaza 1, FS 1132 from Room 103 wall fall.

Plate 6.8. Bracelet fragment of Glycymeris gigantea from the fill between the bench and wall of Kiva 15 at Pueblo Alto: FS 5453.

Table 6.10. Bead blanks, 29SJ 389 (Pueblo Alto)

Time Period (A.D.)	FS No.	Provenience	MEASUREMENTS (cm) Diam. 1	Diam. 2	Thick.	Comments
Turquoise 920-1220	6964	Rm. 145, Fl. 2, Ly 10, fill	0.76	0.73	0.19	Disk shaped. Ground 2 sides. Polished. 10 BG 6/8.[a]
	6332	Rm. 147, Ly 2, Lv 5	0.42	0.57	0.28	Perf. 0.25 drilled through from 1 side. Piece ground 1 side, 1 edge, somewhate needle shaped. 5 BG 8/4.
	3154	East Ruin, Rm. 14, TT 2, Lv 5	0.39	0.41	0.15	Ground 2 sides, polished. Disk shaped. 5 BG 7/6.
Bone 1020-1120	4594	TM 239, Lv 7	5.73	2.68	0.39-0.45	Bone flesher made from Artiodactyl humerus. Decorated or possibly used for bead blanks. Ground on all edges. Highly polished on one surface. Decoration: two rows of 3 and 4 disks.

[a] Munsell color chart code used to determine turquoise color.

The second bell (FS 1132) was found in Room 103, upper wall fall, and is dated to the A.D. 920-1220 period. It fits DiPeso's (1974:7:510) type IAla and Pendergast's (1962) IAla-i forms; it is similar to Judd's (1954: Figure 18a) bell in which the loop was molded separately from the body and later fused. The pellet remains intact inside the bell and is made of stone or clay.

DiPeso (1974:7:510) has reviewed the distribution of all types of copper bells throughout the American Southwest and Mesoamerica. The two types of copper bells from Pueblo Alto represent the most widespread of all types known archeologically. They are also the plainest. It is noteworthy that the distinguishable copper artifact class recovered from sites in the southwestern United States, compared to other Middle American sites, is copper bells. At Casas Grandes, DiPeso lists 14 different copper classes. These numerous classes and the manufacturing materials found at Casas Grandes suggest that it was a manufacturing center and that the bells found in the Chaco area were probably obtained through some type of trade network from that south. Because Casas Grandes dates to a later time period than Pueblo Alto (LeBlanc 1980; Lekson 1981), the exact source is unknown.

Bracelet fragments/pendants

A total of 55 artifacts were classified as either bracelet fragments or fragments reused as pendants (Table MF-6.5). Six pieces fell into this latter category.

One fragment was identified as Chama echinata by Helen DuShane; the remainder were classified as Glycymeris gigantea. These were found throughout all time periods at the site and appear in several proveniences. A cache of 16 (FS 887) was found in Plaza Feature 1, Room 4, Test Trench 4, which has been dated to A.D. 920-1220. The next highest number (seven) from any one area was recovered from Plaza 1, Grid 8, Layers 15, 16, and 17. These three layers are either below the lowest floor (No. 9) or just above it (Layer 16) and represent the earliest use areas in the plaza. Room 112, Floors 3 and fill below it, also reveal seven fragments. Both of these proveniences are assigned to the A.D. 920-1020 period. Plate 6.8 illustrates one of the bracelet fragments (FS 5453 from Kiva 15) that retains the edge of the shell for decoration. Most bracelet fragments recovered were plain.

Discs

A single argillite disc (FS 5831) was recovered from Room 229, Layer 4, wall fall, structural rubble, which is dated to A.D. 1020-1120. The disc is oval in shape and measures 2.17 cm on the long axis, 1.99 cm on the short axis, and is 0.32 cm thick. It was ground on both flat sides and around the edge as evidenced particularly by the presence of striations on all of these areas (Plate 6.9).

Plate 6.9. Argillite artifacts from Pueblo Alto: FS 5831 (disk from Room 229), FS 4011 (effigy from Plaza 1), FS 4542 (unidentified object from the Trash Mound), and FS 2889 (pendant blank from Room 142).

Plate 6.10. Black artifacts from Pueblo Alto: FS 4781 (goethite effigy from Trash Mound); FS 4644, FS 4822 (lignite effigies from Trash Mound); FS 2199, FS 6500 (lignite pendants from Room 145 and Kiva 10); FS 606, FS 4324 (lignite pendant blanks from Other Structure 7 and Plaza 1).

Effigies/zoomorphic figures

Nine pieces were classified as effigy figures and will be discussed individually below. In addition, a selenite pendant (FS 6509) had a shape that could be classified as an effigy, but because of its predominantly pendant form, it is placed under that category. Similarly, three pieces of turquoise inlay were shaped into zoomorphic forms, but were found with numerous other inlays and are included under that artifact class.

A single argillite artifact (FS 4011) found in Plaza 1, Grid 9, surface, is dated to A.D. 920-1120. A stylized bird (Plate 6.9), it is 3.43 cm long, 1.61 cm wide, and 0.57 cm thick. It had been ground on all sides, polished on one surface, carved and notched to form the design, and had evidence of striations on the two flat surfaces.

A well-worked piece of goethite (FS 4781) was recovered from the Trash Mound, Grid 238, Layer 104, which was dated to A.D. 1020-1120. It is 4.16 cm long, 0.69 cm wide, and 0.78 cm thick. A perforation on the underside suggests that it may have been used as a pendant or attached to some article of clothing. This piece was carefully ground and polished on all sides and edges and exhibits careful carving to obtain its shape (Plate 6.10). Striations were evident on only one surface, and the perforation is biconical.

Two zoomorphic lignite figures, both dating to the period A.D. 1020-1120, were recovered from Pueblo Alto (Plate 6.10). FS 4644 was found in Slump 3 of the Trash Mound, Grid 267. Although it was broken and only part was recovered, a sufficient portion remained to suggest that its original shape was that of a frog. It is 3.67 cm long, 1.68 cm wide (broken), and 0.95 cm thick. A perforation measuring 0.39 cm is also present. FS 4822 from the Trash Mound, Grid 294, Layer 97, is a complete piece resembling a dog or a fox. It is 2.16 cm long, 0.61 cm wide, and 0.58 cm thick. A perforation drilled from two sides is 0.22 cm in diameter.

An opal (FS 2064), which is unusual in shape and may represent some type of anthropomorphic or zoomorphic figure (Plate 6.11), was found in Room 145, fill above Floor 1. This is dated to A.D. 920-1220. Although broken off at the top and bottom, it had been ground and polished and has an incised line and what resembles a perforation. However, the piece is rough on that surface and may be broken. It measures 2.50 cm on the long axis, 1.35 on the perpendicular axis, and 1.32 cm thick.

Three unusual pieces of selenite were recovered (Plate 6.12). Because their shapes were considerably different from the other pieces of selenite found at the site, they may represent fetishes of some sort. FS 7246 from Room 112, Layer 8, Level 1, is dated to the period A.D. 920-1020. It measures 2.01 x 0.54 x 0.64 cm in length, width, and thickness. Exact form is indeterminate. FS 1133 from Room 103, Test Pit 5, Layer 2

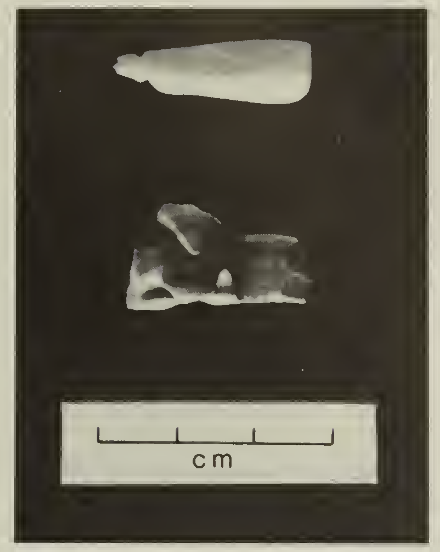

Plate 6.11. Effigies from Pueblo Alto: FS 2064 (Opal effigy from Room 145) and FS 664 (Oliva incrassata from site surface).

Plate 6.12. Selenite and quartz artifacts from Pueblo Alto: FS 7246, FS 1133, FS 1173 (selenite effigy-like pieces from Room 112 and Room 103); FS 4347 (quartz pendant from Plaza 1); FS 5467, FS 4545, FS 6509 (selenite pendants from Room 110, Trash Mound, and Kiva 10); FS 6509 (selenite pendant blank from Kiva 10).

alluvium, dated to the period A.D. 920-1220. It measures 2.78 x 1.61 x 0.36 cm in length, width, and thickness and has evidence of grinding along one edge. No specific form can be determined. FS 1173 was also found in Room 103, but its provenience in Other Pit 4 of Floor 1 restricted its dating to the A.D. 1020-1120 period. What resembles a fish tail can be discerned. This piece reveals beveling on one edge and slight carving in one area. It is 2.89 cm long, 1.31 cm wide, and 0.38 cm thick.

FS 664 is part of a _Oliva incrassata_ shell that has been notched, beveled, and carved to some extent (Plate 6.11). It was picked up by tourists from an unknown provenience and, therefore, is dated to A.D. 920-1220. Similar to a bell in shape, this piece measures 2.56 cm long and 1.16 cm wide, with an overall thickness of 0.70 cm.

Gaming pieces

A total of nine artifacts was classified as gaming pieces (Table 6.11). Five of these were made from bone (three artiodactyl, one mammalian, and one from an unidentified species, according to Nancy Akins of the Chaco Center). The similar shapes of the three calcite and one limonite piece (rectangular and/or oval, but somewhat flat and too thick to be classified as inlay) led to their inclusion in this artifact class. Gaming pieces were found throughout all time periods at this site and vary in size (1.89 to 4.04 cm long for complete pieces) and shape (oval to rectangular). Only two of the bone pieces had a crosshatched design incised on one surface (Plate 6.13); the remainder were plain.

Inlay

A total of 162 pieces of inlay was recovered from Pueblo Alto (Table 6.12). The majority of these (123 or 76 percent) were turquoise, and most of the inlays (96.9 percent of the turquoise) were found in the roof fall of Room 142. Included among the materials in this provenience were argillite, calcite, lignite, _Chama echinata_ shell, and turquoise inlay (Plate 6.14). It is possible that these pieces once adhered to a backing, as they were numerous (more than in any other provenience from recent excavations), or they may relate to jewelers working on the roof or a jewelry cache stored in the rafters of the room. A single lapidary abrader was found among the artifacts in the roof fall (Akins 1980), and other ornaments and minerals were recovered from this level (Table MF-6.1). It is more likely, therefore, that the material was part of a cache or decorated piece rather than material from a jewelry workshop area.

Detailed information on all pieces of inlay is summarized in Table MF-6.6. In general, pieces were rectangular (122 or 75.3 percent), but there were also bird forms (3 or 1.8 percent), crescent-shaped pieces (5 or 3.1 percent), triangular pieces (17 or 10.5 percent), trapezoidal pieces (11 or 6.8 percent), and irregularly shaped pieces (4 or 2.5 percent). These pieces were ground on the two flat surfaces and along the

Table 6.11. Gaming pieces, 29SJ 389 (Pueblo Alto).

Time Period (A.D.)	FS No.	Provenience	MEASUREMENTS (cm) Length	Width	Thick.	Comments
Bone						
920-1020	2587	Rm. 139, Fl. 2, Ly 10	2.01	0.84	0.33	Artiodactyl long bone, roughly rectangular ground 2 sides, 4 edges with striations. Slight polish, no designs.
1020-1120	1292	Rm. 103, Fl. 3, plaster	1.89	1.04	0.24	Artiodactyl fragment, oval. Poorly ground on edges, some polish on raised edges 1 side.
	4612	TM 211, Lv 11	2.14	1.11	0.25	Artiodactyl long bone, rectangular with 2 rounded edges. Ground 4 edges, 1 surface polished. Cross-hatched design.
	4593	TM 239, Lv 6	2.23	0.98	0.26	Large mammalian long bone, rectangular with rounded edges. Ground 2 sides, 4 edges, slight polish on side with incised cross-hatched design.
1120-1220	4753	TM 260, Ly 104	1.66	0.70	0.27	Broken 1/3. Probably oval, well ground on edges.
Calcite						
920-1220	4180	Pl. 1, Gr. 195, Ly 1&2	4.04	0.71	0.29	Ground 2 sides, 4 edges, striations. Rectangular.
	4232	Pl. Fea. 4, Kiva WC	1.37	0.67	0.24	Ground 2 sides, 3 edges, striations. Rectangular. Broken half.
1020-1220	6502	Kiva 10, Lv 17	3.49	1.25	0.29	Ground 2 sides, 1 edge, striations. Rectangular. Broken quarter.
Limonite						
1020-1120	4769	TM 210, Ly 56	1.27	1.12	0.38	Ground 2 sides, 3 edges, striations. Oval. Broken half.

Table 6.12. Inlay by material type and time, 29SJ 389 (Pueblo Alto).

Material Type	Total No.	A.D. 920 -1020	A.D. 920 -1120	A.D. 920 -1220	A.D. 1020 -1120	A.D. 1020 -1220	A.D. 1120 -1220	Undated
Argillite	17	1	-	15	-	-	1	-
Calcite	3	-	-	2	-	1	-	-
Lignite	6	-	-	6	-	-	-	-
Shale	1	1	-	-	-	-	-	-
Shell *Chama echinata*	12	-	-	12	-	-	-	-
Turquoise	123	-	-	118	4	-	1	-
Totals	162	2	-	153	4	1	2	0

Plate 6.13. Bone artifacts from Pueblo Alto: FS 4612, FS 4593, FS 2587 (gaming pieces from the Trash Mound and Room 139); FS 6518 (from Kiva 10); FS 6501 (pendant from Kiva 10); and FS 450 (whistle from Room 202).

Plate 6.14. Sample of inlay made from turquoise, shale, lignite, and Chama echinata found in roof fall of Room 142 at Pueblo Alto: FS 2714. Note bird-shaped turquoise piece in lower right of photograph.

edges. Only 11 (6.8 percent) had evidence of beveling along one edge; 2 also had evidence of drilling for perforations; 68 (41.99 percent) were shiny or polished (shell and turquoise only). Colors of the turquoise were coded with a Munsell color chart containing the blue green spectra. Most turquoise inlays (88 percent) were at the bluer end of the range (7.5 and 10 BG).

Ornaments, other or unidentified

These categories were used when there was no way to describe an artifact distinct enough to merit notation but without a specific shape.

One bone artifact, FS 6518, found in Kiva 10, Level 26, was classified as an ornament. It dates to A.D. 1120-1220. Somewhat rectangular in shape, this large, mammalian, long bone had been ground on all four edges. A perforation measuring 0.51-0.81 cm went through this piece, which was 2.94 cm on the long axis, 1.67 cm on the short axis, and 0.70 cm thick. A notch had been carved into one end, and two lines were incised or carved around the lower end (Plate 6.13).

Eight artifacts were listed as "Other" (Table MF-6.7). One argillite piece, FS 4542, came from the Trash Mound and dates to A.D. 1020-1120. It was irregularly shaped, ground, carved, notched, and drilled (Plate 6.9). A calcite piece, FS 6291, was recovered in Room 147, Layer 3. It is rectangular and dates to A.D. 920-1220. One tabular piece of limonite, FS 1136, from Room 103, Layer 2, Level 4, had been polished. This dates to A.D. 920-1220. A key-shaped piece of sandstone, FS 6735, was found during wall clearing operations in Kiva 10 and dates to A.D. 920-1220 (Plate 6.15).

Three pieces of Haliotus cracherodii shell species were recovered at the site (Plate 6.15). Their form did not suggest their function, but it is assumed that these were ornamental in value to the Chacoans as they had been imported from a long distance. Other shells of this species usually have been in the shape of pendants. FS 1143, from Room 103, floor feature above Floor 1, was an irregularly shaped and thin piece. It may be the remaining layer of a piece that has deteriorated. FS 1142 from Room 103, Layer 2, Level 6, is trapezoidal. Both this and FS 1143 had been ground along the edges and date to A.D. 920-1220. FS 6513 from Kiva 10, Level 11, is rectangular and dates to A.D. 1020-1220.

A triangular, flat piece of Spondylus princeps unicolor, FS 6781, was found in the fill above Floor 1 in Room 143 (Plate 6.16). It had been ground on both sides and edges and was polished. It dated to the period A.D. 920-1220.

Three items were listed as unidentified (Table MF-6.7). A broken Olivella dama shell (FS 4643) was picked up while archeologists were cleaning profiles in Test Trench 1 of the Trash Mound. It dates to A.D. 1020-1120. A freshwater clam (FS 4666) came from Layer 13 of Grid 126 of the Trash Mound. It is an irregular, broken piece dating to A.D. 920-

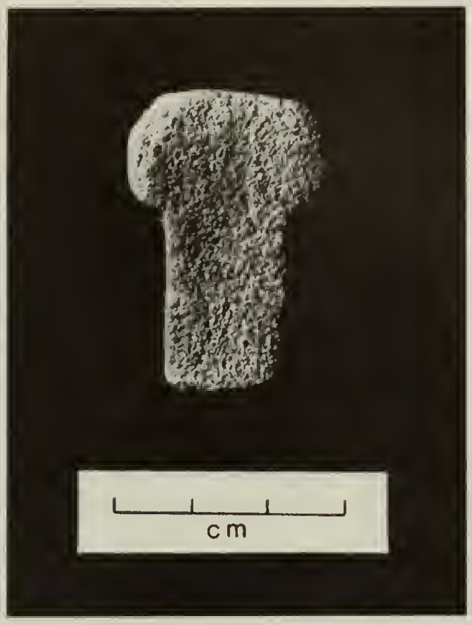

Plate 6.15. Sandstone, key-shaped piece of Kiva 10 at Pueblo Alto: FS 6735.

Plate 6.16. *Haliotus cracherodii* and *Spondylus* pieces from Pueblo Alto: FS 1143, FS 1142, FS 6513 (from Room 103 and Kiva 10); FS 6781 (from Room 143).

1020. A broken but worked shale piece (FS 4521) may represent a tcamahia fragment. It was found in Level 5, Grid 127 of the Trash Mound and dates to A.D. 1020-1120. Another tcamahia fragment (FS 6504) was recovered from Plaza 1.

Pendants and pendant blanks/fragments

A total of 23 pendants includes 9 different material types. Details are summarized in Table 6.13. Because of the range of time periods and material types utilized, it is difficult to make any comparative statements based on this sample. This collection is illustrated in part in Plates 6.3, 6.4, 6.5, 6.10, 6.12, 6.13, and 6.17. Most numerous were turquoise pendants (8 or 28.8 percent); these ranged in color from green yellow hues to the bluer of the blue green hues, which were coded with a Munsell color chart.

Sixteen pendant blanks/fragments (Table 6.14) were made from six material types and were found throughout all time periods. These are illustrated in Plates 6.5, 6.9, 6.10, 6.12 and 6.17. Again, turquoise pendant pieces were most numerous (6 or 26.6 percent). In neither category are there any clusters of artifacts from a single provenience. However, a few were found with other ornaments in the roof-fall levels of Room 142. But this artifact class is considerably less common than the beads or inlay from this site.

Rings

Three rings were recovered from Pueblo Alto (Plate 6.18).

FS 7025 is a bone ring from Room 112, Layer 7 dated to A.D. 920-1220. Made from a canid (coyote or dog, first cervical vertebrae, identified by Nancy Akins), this piece had been ground on two edges and had some evidence of polish and a few striations. It has both a natural notch and a parallel linear design. It is 2.13 cm in diameter and 0.88 cm in band width.

FS 1144 is a shale ring from Room 103, Floor 1 and is complete. It dates to A.D. 1020-1120. Its external diameter is 1.69 cm, and the band width is 1.25 cm. It had been ground on two sides and had evidence of polish and scratch lines. The exact material type has not been determined.

A fragment of a serpentine ring (FS 2756) was picked up in Room 142, Layer 6, Level 6. Although it was broken into a small portion, one could determine that both edges of the band (width 1.60 cm) had been ground. It dates to A.D. 920-1220.

Table 6.13. Pendants, 29SJ 389 (Pueblo Alto).

Time Period (A.D.)	FS No.	Provenience	MEASUREMENTS (cm) Length	Width	Thick.	Perf.	Comments
Bone							
1120–1220	6501	Kiva 10, TT 1, Lv 16	3.39	2.62	0.15	0.17–19	Bone type unidentified. Shape probably rectangular; piece broken. Ground 3 edges, striations, 2 perfs. in corners.
Ceramic							
920–1020	4355	Pl. 1, Gr. 30, TT 3, Lv 5					Not found in collections.
Gypsite	585	Kiva 3, WC, prob. pilaster base	0.83	0.40	0.28	0.23	Rectangular. Some polish on back.
			0.76	0.37	0.48	0.23	Teardrop. Top of perforation eroded.
			0.58	0.34	0.23	0.20	Rectangular. Two carved lines on sides.
Quartz crystal							
920–1020	4347	Pl. 1, Gr. 30, TT 3, Ly 6, Lv 3	1.83	0.31	0.31		Needle shaped. Drilled 2 sides, 1 cut.
Selenite							
1020–1120	5467	Rm. 110, Ly 1, fill	1.97	1.92	0.09	0.24	Trapezoidal. Drilled 1 side.
	4545	TM 211, Lv 6	2.19	1.30	0.25	0.24	Rectangular. Ground 2 sides, drilled 2 sides.
1120–1220	6509	Kiva 10, Lv 24	2.18	0.78	0.41	0.08	Anthropomorphic. Ground 2 sides, drilled 1.
Shale							
920–1220	2199	Rm. 145, Ly 7, Lv 7	1.48	1.03	0.19	0.20	Trapezoidal. Ground, polished all sides, edges. Drilled 1. Black, ? jet.
1120–1220	6500	Kiva 10, Lv 15	1.31	0.58	0.40	-	Rectangular. Ground all sides, edges. Polished 1 side, beveled 2, carved 1, cut 1, notch 1, striations. Black, ? jet.
Shell							
Chama echinata							
920–1020	6073	Rm. 146, Fl. 2, OP 1	0.85	0.84	0.29	0.23	Triangular. Ground 2 sides, 4 edges. Polished all over. Beveled 1, drilled 2.
1020–1120	1643	Rm. 110, Fl. 1, WN 10	0.84	0.52	0.46	0.23	Rectangular. Ground and polished all sides and edges, drilled 2.
1120–1220	6504	Kiva 10, TT1, Lv 19	1.95	1.23	0.81	0.26	Irregular. Ground and polished all sides and edges. Drilled 2.
Glycymeris gigantea							
920–1220	6271	Rm. 147, Ly 2, Lv 5	0.77	0.45	0.35	0.23	Rectangular. Ground and polished all sides and edges. Striations, Drilled 2.
Turquoise							
920–1220	4245	Pl. 1, Gr. 195, Ly 3	1.15	0.87	0.14	0.18	Rectangular. Ground 2 sides, 4 edges, drilled 1, striations. 5 GY 7/2.[a]
	-	Rm. 103, backdirt	1.14	0.87	0.14	0.22	Rectangular. Ground 2 sides, 4 edges, drilled 2. 5 GY 7/2.
	6007	Rm. 146, Ly 3, Lv 6	1.21	0.89	0.61	0.20	Anthropomorphic. Ground 1 side, 1 edge, drilled 2. 10 GY 7/2.
1020–1120	1206	Rm. 103, Fl. 2, Ly 3, fill	1.86	1.44	0.24	0.18	Trapezoidal. Ground and polished 2 sides, 4 edges, beveled 3, drilled 2, striations. 5 BG 7/6.
	7092	Rm. 112, WN 2	0.90	0.80	0.10	0.10	Rectangular. Ground 2 sides, polished 2, drilled 2.
	4559	TM 323, Lv 14	1.16	1.28	0.28	0.19	Triangular. Ground 2 sides, 3 edges, beveled 2, drilled 2. 10 BG 7/8.
	4733	TM 154, Lv 41–35	0.98	0.68	0.12	0.08	Rectangular. Ground 2 sides, 4 edges, polished 1, beveled 1, drilled 2. 7.5 BG 7/8.
1120–1220	6501	Kiva 10, Lv 16	1.05	0.82	0.14	0.16	Rectangular. Ground 2 sides, 4 edges, drilled 2. 2.5 BG 7/4.

[a]Munsaell color chart code used to determine turquoise color.

Table 6.14. Pendant blanks/fragments, 29SJ 389 (Pueblo Alto).

Time Period (A.D.)	FS No.	Provenience	MEASUREMENTS (cm) Length	Width	Thick.	Comments
Argillite						
920-1020	2889	Rm. 142, Fl. 3, Ly 8	1.15	0.78	0.17	Rectangular. Ground 2 sides, 3 edges, cut 1.
Calcite						
920-1220	4279	Kiva 14, WC	1.77	1.69	0.31	Trapezoidal. Ground 2 sides, 4 edges, striations.
	4280	OS 6, WC	3.17	2.83	0.34	Irregular. Broken, ground 2 sides, 3 edges, striations.
1120-1220	6504	Kiva 10, Lv 19	1.48	0.72	0.27	Rectangular. Ground 2 sides, 4 edges, striations.
	4261	Pl. 1, Gr. 115, Ly 3	2.96	2.28	0.35	Trapezoidal. Ground 2 sides, 3 edges, striations.
Undated	4311	Pl. 1, Gr. 35, Fl. 5, Ly 1	2.42	0.74	0.27	Rectangular. Ground 2 sides, 4 edges, striations. Drilled 1 side, perf. 0.21 cm.
Lignite						
920-1220	606	OS 7, WC	2.68	1.47	0.35	Rectangular, broken. Ground 2 sides, 3 edges, polished.
1020-1220	4324	Pl. 1, Gr. 273, Fl. 1	1.73	1.21	0.27	Rectangular. Ground 2 sides, 4 edges.
Selenite						
1120-1220	6509	Kiva 10, Lv 24	1.94	1.41	0.37	Rectangular. Ground 2 sides, 2 edges.
Shell						
Olivella dama						
920-1220	2715	Rm. 142, TT 1, Lv 11	0.62	0.55	0.07	Disk. Ground all sides, edges, drilled 1 side with 0.24 cm. perf. Striations.
Turquoise						
920-1220	2734	Rm. 142, Ly 6, Lv 5	1.22	0.90	0.22	Oval disk. Ground 2 sides, edges. 10 BG 6/8.[a]
	6270	Rm. 147, Ly 2, Lv 5	0.96	0.70	0.17	Rectangular. Ground 2 sides, 4 edges, polished 1, striations. 2.5 BG 7/6.
	4279	Kiva 14, WC	0.93	0.63	0.22	Rectangular. Ground 2 sides, 4 edges, polished 1. Incomplete perf. 0.25 cm. 2.5 BG 9/2.
1020-1120	4773	TM 210, Ly 45, Fea. 1	1.11	0.73	0.27	Needle. Ground 1 side, drilled 1 with incomplete perf. 7.5 BG 7/6
	4790	TM 238, Ly 76	1.46	0.91	0.29	Needle. Ground 2 sides, 4 edges. 7.5 BG 7/8.
	4600	TM 239, Lv 13	1.84	1.15	0.30	Rectangular. Ground 2 sides, 4 edges. 2.5 BG 7/6.

[a]Munsell color chart code used to determine turquoise color.

Plate 6.17. Calcite artifacts from Pueblo Alto: FS 4279, FS 4280, FS 4311 (pendant blanks from Kiva 14, Other Structure 6, and Plaza 1).

Plate 6.18. Rings from Pueblo Alto: FS 7025 (bone from Room 112); FS 1144 (shale from Room 103); FS 2756 (serpentine fragment from Room 142).

Whistle

Made from a lepus right femur, this whistle (FS 450) was found in Room 202 during wall clearing. The tube, which was 5.64 cm long and 0.82 cm in diameter, had a rectangular hole in approximately the center (Plate 6.13). It had been ground on both ends and was highly polished. No inside stop was found.

Other Minerals

A number of modified mineral pieces testify to the ability of the Chaco inhabitants to work a number of materials, yet select those best suited to their needs, values, and technology. Calcite was recovered from several proveniences. Plate 6.19 illustrates the grinding evidence typical of these artifacts; the material in this photograph was recovered from Room 145, Layer 7, Level 7. These pieces should be compared with those in Plate 6.17.

Jet/lignite is a much softer material but was also used; Plate 6.20 shows a modified rectangular piece (FS 5043) recovered from Plaza 1, Grid 301. Harder material was used, also; a piece of galena (FS 4323 from Plaza 1, Grid 273) had been modified to a rectangle. Use of this material is much more restricted than the softer lignites.

Gypsite was the most common mineral recovered from this site (39.7 percent) followed by selenite (16.9 percent) and turquoise (8.3 percent). These three minerals made up 64.9 percent of all the material analyzed in this study. Because malachite and azurite were collected at all times by the excavators, while gypsite may not have been saved in all instances, these figures are biased. Soft minerals were present in the following amounts:

Mineral	Pigment color	No. of Pieces	% of Soft Minerals
Gypsite	White	1,322	54.9
Selenite	White	562	23.4
Malachite	Green	155	6.4
Hematite	Brown/red	132	5.5
Limonite	Yellow/brown	134	5.5
Azurite	Blue	101	4.2
Total		2,406	99.9

This suggests that white was the most desirable pigment, followed by green, then the red/brown/yellows, and blue. If the red/brown/yellows are combined (which may be relevant as some of the hematites and limonites are not always as clearly distinguishable), these positions switch somewhat with the blue-green spectrum totalling only a few less. In most other sites, the blues and greens are fewer than the reds/browns/yellows. But in all cases, white was the predominant color.

Plate 6.19. Worked materials from Pueblo Alto: FS 2198 (calcite from Room 142).

Plate 6.20. Worked materials from Pueblo Alto: FS 4323 (galena from Plaza 1); FS 5043 and FS 2723 (lignite/jet from Plaza 1 and Room 142).

Unusual or Notable Groupings

Five proveniences contain an unusual number of ornamental artifacts:

Four floors in Room 103 contained ornaments dated to A.D. 1020-1120. On each of these floors and in the fill, ornaments appeared consistently.

Floor 1, floor and pits:	1 turquoise inlay 1 shale ring 6 calcite beads
Fill above Floor 2:	1 turquoise pendant 2 turquoise beads
Floor 2:	1 shale bead 1 turquoise bead 2 calcite beads
Fill above Floor 3:	1 argillite bead
Floor 3:	1 turquoise bead 1 bone gaming piece
Fill above floor 4:	4 shale beads
Floor 4:	1 *Glycymeris* bead 5 shale beads
Fill above Floor 5:	2 shale beads

This distribution is interesting, as there were some artifacts from each floor except Floor 5. When the presence of lapidary abraders was reviewed (Akins 1980), only a passive abrader was recorded in the post-occupational fill above Floor 1. Although Akins (1980:224) noted that this room contained "the largest number of abraders from any one provenience other than the trash mound," which totaled 12.7 percent of her abraders at this site, only one of these was classified as a lapidary stone. Based on the number of ornaments, one would expect to find numerous lapidary stones on one or several floors if this had been a workshop area. The lack of manufacturing debris throughout this room and the variety of material types for beads suggest that the occupants had access to ornaments but not that they manufactured them in this area.

In Room 142, Layers 4, 5, and 6 were associated with roof fall and are dated to the entire time span, A.D. 920-1220. The number of ornaments found in these layers is extraordinarily high when compared to the rest of the site, especially for turquoise inlay. These are listed by material type below.

Calcite	3 modified 1 inlay
Chama echinata	12 inlay
Olivella dama	1 pendant blank
Turquoise	114 inlay 3 zoomorphic inlay 1 pendant blank 6 debris
Lignite	6 inlay 1 unidentified
Argillite	15 inlay
Serpentine	1 ring

Layer 5 also contained one active abrader (Akins 1980:228, Table 8.2). The turquoise pendant blank and the six pieces of turquoise debris might indicate workshop activity. However, the number of finely finished turquoise inlays, in conjunction with shell, calcite, and lignite inlays, leads one to question whether or not these were part of a finished piece whose backing had deteriorated through time. Another possibility is that these had been placed into a perishable container and placed in the rafters; when the roof fell, these were scattered among the remains. In either case, the probable association with the roof is high.

The floors of this room date from the A.D. 920-1220 period and contain no turquoise artifacts. Only two shale/argillite pieces were found below Floor 1: one on Floor 3 and one on Floor 6. Nineteen shale beads from below Floor 2 were also recovered. This pattern contrasts with the floors of Room 103, which had ornaments made from a variety of materials on all floors.

Kiva 3 was not totally excavated. However, walls were cleared, and Test Trench 1 crossed it in an east-west direction (Windes 1977:46-48). While excavating the trench, archeologists encountered a small pocket that was probably a pilaster; it contained a cache of 2 gypsite beads and 3 gypsite pendants, and 52 pieces of turquoise scrap (Windes, Volume II of this report). These may be pilaster offerings similar to those found in kivas at Pueblo Bonito (Judd 1954).

A north-south trench, in addition to part of the east-west trench mentioned above, crisscrossed Plaza 1, Grid 8 which is located directly east of Kiva 3. Although there were a few ornaments on Floor 1 of the Plaza (one modified turquoise piece dated to A.D. 920-1220) and Floor 2 (four calcite beads and one calcite inlay dated to A.D. 1020-1220), the majority of the ornaments were found in the A.D. 920-1020 proveniences:

Floor 4	1 turquoise modified	
Floor 8	5 *Glycymeris* beads	
	2 turquoise modified	
Floor 9	1 *Chama echinata* bead	
	1 *Glycymeris* bracelet fragment	
	1 freshwater clam shell	
	1 shale bead	
	1 turquoise modified	
Below Floor 9, Layer 17	2 turquoise pieces	
	1 shale bead	
	1 *Glycymeris* bracelet fragment	
	1 calcite bead	
	1 *Argopectin circularis* shell	
	1 hematite	
Layer 15	91 beads:	23 calcite
		63 shale
		2 turquoise
		1 *Glycymeris*
		1 bone
		1 *Chama echinata*
	5 *Glycymeris* bracelet fragments	
	1 shale inlay	
	22 turquoise:	8 modified
		5 unmodified
		9 debris

The material in Layer 15 came from a trash-filled pit; the artifacts contained in it suggest the remains of a jeweler's workshop. This layer also had one active lapidary abrader. Where the original work area was located is unknown, but the artifacts suggest that it was somewhere in the earliest rooms at Pueblo Alto. Comparisons of shale beads (see above) suggest that the beads from Layer 15 are different from those in Room 142 below Floor 2.

Plaza Feature 1, Room 4. In Layer 2, which is postoccupational fill above the first floor, a cache of 16 *Glycymeris* bracelet fragments was found. These were dated to the period A.D. 920-1220.

Color of Turquoise Pieces

A total of 259 turquoise artifacts was coded for color with a Munsell color chart (blue green hues) supplemented by a rock-color chart. This represents 94.8 percent of all the turquoise artifacts from this site; among those not color-coded were three pieces sent to Brookhaven National Laboratory for neutron-activation analysis of chemical content and some were pieces to small to handle.

Examination of hue revealed that these were generally at the bluer end of the spectrum, with very few in the green yellows or greens. This breakdown is illustrated in Figure 6.1 and below.

Hue	n	Percentage
5 GY	3	1.25
10 GY	2	0.77
5 G	5	1.93
10 G	2	0.77
2.5 BG	37	14.28
5 BG	24	9.26
7.5 BG	83	32.04
10 BG	101	38.99
5 B	2	0.77
Totals	259	99.94

Examination of value and chroma revealed that 85 were coded as 7/8 (32.8 percent), 59 as 6/8 (22.77 percent), and 46 as 7/6 (17.76 percent). This accounts for 73.3 percent of all the coded value/chroma combinations. When the hues, values, and chromas were combined, the following results were obtained.

Hue	n	Percentage
7.5 BG 7/8	30	11.6
7.5 BG 6/8	24	9.3
7.5 BG 7/6	16	6.2
10 BG 7/8	50	19.3
10 BG 6/8	34	13.1
10 BG 7/6	8	3.1
Totals	162	62.6

The two most popular colors comprised 32.4 percent, the three most popular 44.0 percent and the four most common colors 53.3 percent, or over half of all the artifacts coded for color. This suggests that the inhabitants of Pueblo Alto were definitely interested in the bluer end of the spectrum and the higher quality of turquoise (quality judged by intensity of color--value and chroma).

Because inlay was the most numerous turquoise artifact class, these pieces were evaluated separately. FS 2714 from the roof fall of Room 142 had 93 inlays; Figure 6.2 depicts these graphically by hue. Again, the

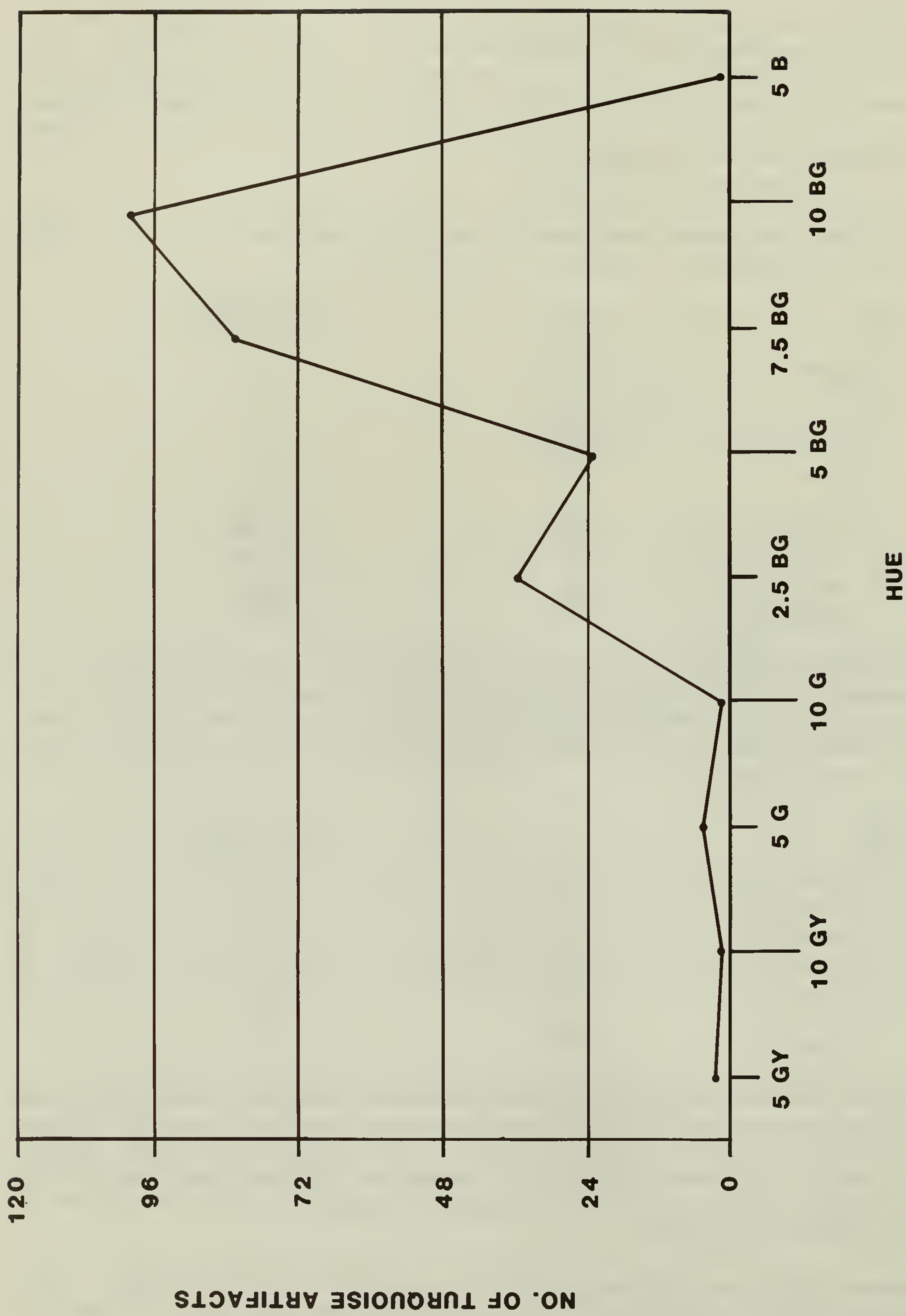

Figure 6.1. Turquoise hues at 29SJ 389 (Pueblo Alto).

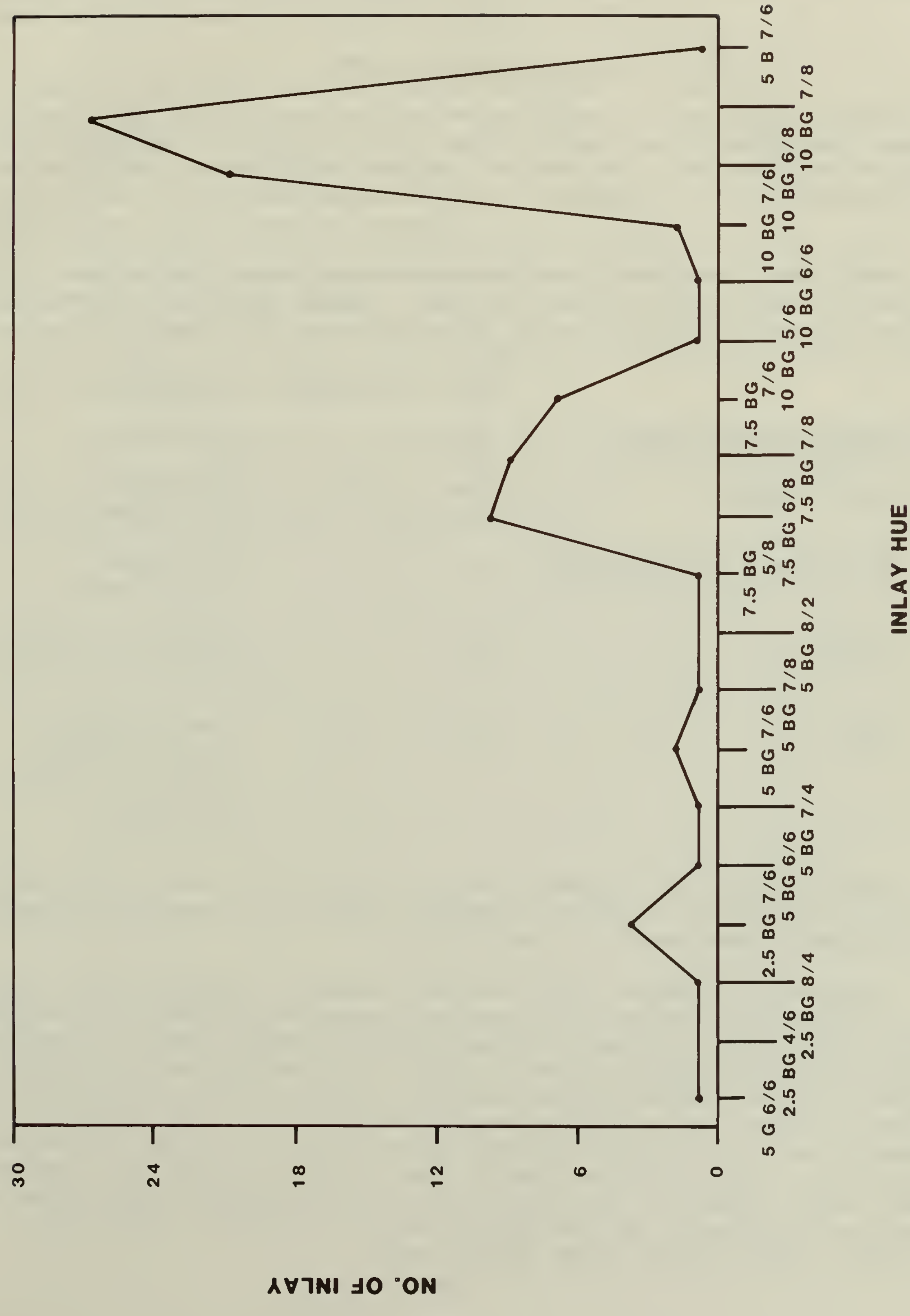

Figure 6.2. Turquoise inlay from 29SJ 389 (Pueblo Alto).

peak was at 10 BG with the hues falling off rapidly on the blue side but not so rapidly on the green side of this value. A second peak was seen in the 7.5 BG. However, no artifacts fell within the GY category.

Summary and Conclusions

Pueblo Alto was a townsite excavated by the National Park Service during this project, but the 10 percent sample limits the number of conclusions that one can draw from the analysis of ornaments and minerals. Given these limitations, however, the following points can be made.

The number of different material types and shell species at this site is larger than those from other sites excavated during the National Park Service's survey and excavation project. Among these are a number of material types with fairly limited distribution in the canyon:

	Total	No. at Alto	Elsewhere
Argopectin circularis	2	1	29SJ 627
Chama echinata	21	19	29SJ 629 Kin Kletso
Choromytilis palliopunctatus	2	1	Kin Kletso Arroyo, Bc51
Spondylus	4/5	2	Pueblo del Arroyo, Bc 51
Copper	34	21 3 6 1 1	Pueblo Bonito Casa Rinconada Pueblo del Arroyo 29SJ 633 Talus Unit

However, this does not mean that all exotics were found in the larger sites; see the report on 29SJ 627 (Mathien 1985) for a detailed discussion of rare shell items found at a small site.

Examination of beads from this site initially suggested that there was a tendency for bead size to increase between the periods A.D. 920-1020 and A.D. 1020-1120. Although the sample size is small, this trend was not confirmed for all material types; instead, it is suggestive of either (a) better craftsmanship during the earlier period or (b) availability of slightly larger pieces of raw material during later time periods. At present, there is no way to validate these ideas. Also, the variability in bead size during any one period (see site report 29SJ 627, Mathien 1985) places doubts on the observation of size change through time as there were differences in size by provenience in the same time period at that site. This problem needs further study.

A possible jewelry-making area existed at this site. The exact location has not been identified, but the amount of material recovered from the fill below Floor 9 in Plaza Grid 8 suggests that beads and pendants were made from various materials at Pueblo Alto.

Although there is no tight date for the material from Room 142, it is noteworthy that most of the ornament clusters that date to A.D. 920-1020 are from the central area of the pueblo: Kiva 3, Plaza Grid 8, and possibly some material from Room 142. This contrasts with the amount found in the West Wing, where Room 103 had ornaments on all but the lowest floor (A.D. 1020-1120). Because no rooms on the East Wing were excavated, no discussion of this area is possible.

In general, turquoise artifacts at this site tended to be bluer than those found at other sites, e.g., the Pueblo III shrine at 29SJ 423 (Mathien 1985). This may be due to a selection of colors for various artifact types, as inlays were predominant at this site, whereas beads were more common at 29SJ 423.

Considering that only 10 percent of this site has been excavated, note that the rooms at Pueblo Alto did not have as many ornaments as those at Pueblo Bonito (Judd 1954) nor as few as those in Chetro Ketl and Kin Kletso (Hewett 1936; Vivian and Mathews 1965).

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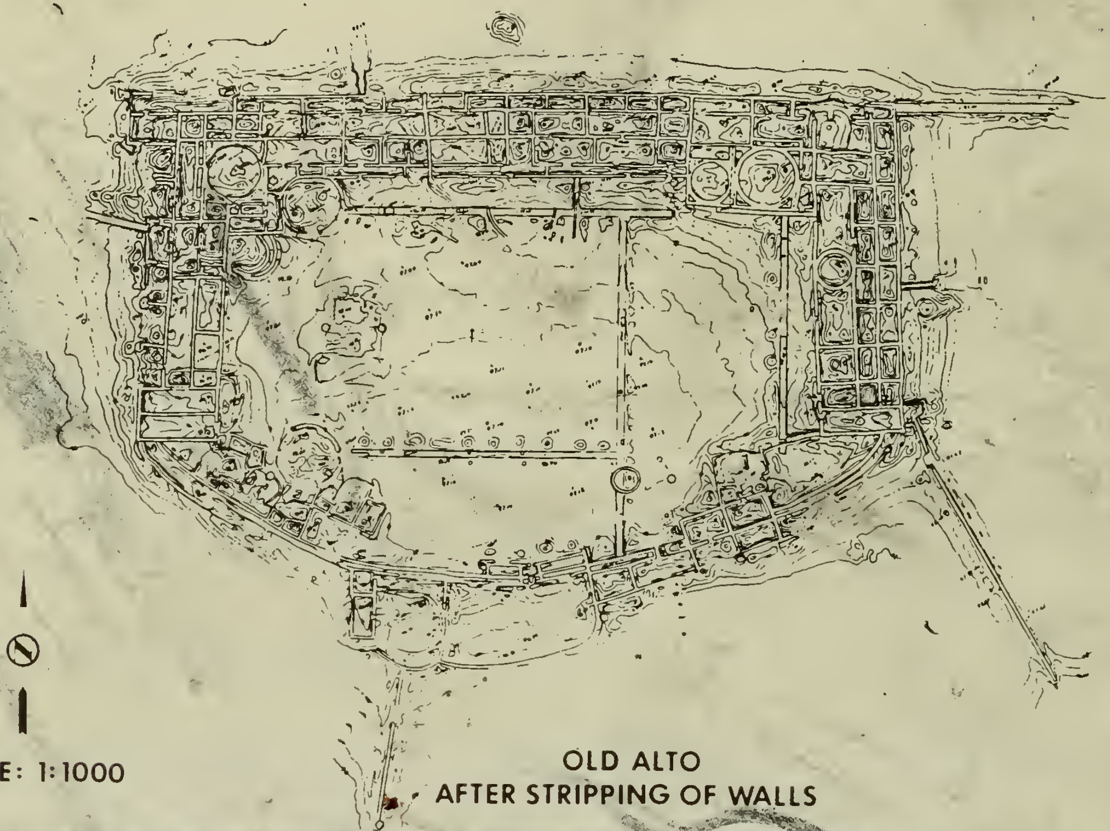

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AFTER STRIPPING OF WALLS